RADIO NEWS

H. GERNSBACK — EDITOR
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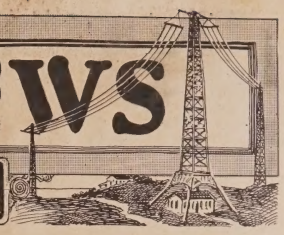


Vol. 2 JULY, 1920 No. 1

Radio in 1945

WE are slowly ascending the steep hill of progress. However, we have still an enormous mountain to climb as far as the radio art is concerned. Compared to the ultimate goal, our present achievements are like the smallest pebble in comparison with Himalaya. Standing on this little pebble, we do not get much of a vantage point, but we can, at least, look back upon the road we travel, and we can also, figuratively speaking, soar toward the peak of the towering mountain above our heads.

Everything in life is comparative. So is progress of the arts and sciences. What appears fantastic and wholly visionary today has a knack of coming true on the morrow. Consequently on looking back only over the microscopically small stretch of time of twenty-five years, we find the art of radio just born. We then had our spark coil connected to a ponderous aerial, and as a receiver we had a tremendously complicated conglomeration of apparatus, comprising coherers, relays, tappers, choke coils, batteries and various other paraphernalia.

Of course, we smile on this today in our very superior manner; particularly when we look at our compact little sets with which, strictly speaking, we need no longer even use an aerial, nor a ground.

We use a little loop of wire three feet square; we have a small vacuum tube and a pair of receivers all encompassed into a box that fits into your suitcase, and lo and behold! We can set up this box, and within the radius of hundreds of miles receive radio music by which we dance. Had we suggested such a thing twenty years ago we would have been most severely condemned as visionaries and dreamers.

If radio has made such tremendous progress in only twenty-five years, what will it be in twenty-five years hence? The imagination fairly staggers at the contemplation of the progress that is coming. But certain things may be prophesied with relative safety. Many scientific prophecies are as certain as the rising of the sun. If you are correct on your premises, you can make certain deductions that we know in advance must come true.

It is therefore safe to say that in twenty-five years hence there will be no such thing as a big ponderous aerial mast even for the powerful radio stations sending messages all around the globe. Probably no aerial will be used at all. Perhaps no ground either. Before we reach that stage someone will go and bore a shaft into the earth, possibly a thousand feet deep, and hang an insulated wire into this shaft. He will probably astound the world by finding that by means of this arrangement messages can be sent and received all over the globe just as easily as having a huge mast towering a thousand feet into the clouds. It is also a safe bet that twenty-five years from now our long-distance stations will be operating with comparatively small power. Bearing our past progress in mind, it should be possible in 1945 to telegraph 12,000 miles, which is half way around the globe, with a power which does not exceed ½ k.w.! Perhaps even this figure is high, and the day is surely coming when it will be possible to detect the waves of a small induction coil all over the globe.

And, one of these days we will wake up and find that some genius has made it possible for us to *see* actual radio waves. And why not? Arguments may be brought against this prophecy by stating that the length of radio waves is such that they can never be perceived by the eye, which is built to perceive light waves only, which have an entirely different wave length. This argument, however, does not in the least influence us for the simple reason that we have already photographed sound waves, altho we cannot see these either. Just how it will be brought about we have, of course, no means of knowing at present.

It is safe to say that twenty-five years hence we will not use telephone receivers with which to receive our messages. What the method will be at that time to receive messages we cannot even guess at. It may be by visual means; it may be by acoustics, or perhaps in a totally unsuspected manner. We venture to say that it might even be accomplisht physiologically. Who dares say that we will not at some future date pick up two metallic handles and "feel" the dots and dashes come in—that is, if we are still using dots and dashes at the time.

Lee de Forest has shown us that a vacuum tube can be used as an *audible* receiver. Who, therefore, dares to deny that some day we will be able to hear telephone messages simply by using a special vacuum tube, which not only will receive messages but will *also reproduce them acoustically*. This, in an experimental way, is already possible today.

One of the coming wonders without doubt is radio movies. Imagine a bank of several hundred special vacuum tubes upon which the light and dark variations of a film are thrown by means of projecting apparatus. Each individual tube will be affected in a different manner. Some tubes will be strongly exposed to the light, while others will be kept in the dark. These tubes will be light-sensitive similar to the Rubidium Cells in use today. Each tube will send out an impulse by undampt radio waves, and as the wave length of each tube differs by a small fraction of one per cent, there will be no interference between the different tubes. At the receiving end the process is reversed, and a similar bank of tubes reconstructs the picture and throws it upon the screen by some intermediary apparatus. Imagine then a central point of the country, such as Denver, which sends out nightly moving pictures by radio. These are then received in every house all over the country without any difficulty; and, of course, it will be no far cry to combine these movies with voices or music as well. All of this may sound wild and woolly and impossible now, but the reader who picks up this magazine in 1945 will smile at the utter simplicity of this editorial because at that time many more wonderful things than the ones mentioned here surely will have come to pass.

H. GERNSBACK.

The Otter Cliffs Naval Receiving Station

By A. F. WALLIS

Chief Gunner (Radio) U. S. N.

In These Illustrations the Upper Left Hand Cut Represents One Type of Field Receiving Booth as Well as a Permanently Adjusted Loop Antenna. No, Reader, the Center Picture Is Not That of a Lighthouse But Is the Radio Compass Station at Otter Cliff. In the Upper Right Picture Is Shown an Experimental Loop Used for High Speed Tests on European Signals. In the Lower Left Hand Corner Is Shown the Approach to the Radio Reservation Showing Steel Masts, Buildings, Field Receiving Booths, and High, Double Barbed Wire Fence With Charged Wires. To the Lower Right Is Shown the Main Gate of the Reservation.

SITUATED far up on the Maine coast, on Mount Desert Island, six and one-half miles from Bar Harbor, is located the U. S. Navy's largest and most important radio receiving station. So much has been heard and publisht of this station that the name has become very familiar, but owing to its remote location few have ventured a visit, and perhaps not a little curiosity exists as to just what the government has establisht there.

The writer had long heard of Otter Cliffs and like others perhaps had formed an uncertain mental opinion or picture as to just what the station really looked like. So much has been heard of the phenomenal receiving conditions there, minimum atmospherics and other desirable factors that one is inclined to regard the location as a sort of a "radio fairy-land".

With the name "Cliffs" in mind, and having visited Bar Harbor from the sea several years ago, it was difficult for the writer to imagine the extremely high and irregular coast line, the highest on the Atlantic coast, as being desirable for radio receiving purposes. Instead he had pictured a few small receiving shacks with several outdoor loops and telegraph poles, with overhanging fog and dampness trickling from the roofs, the fog being recollections of his previous visit to Bar Harbor.

Arriving at Bar Harbor after an hour's pleasant sail, the writer boarded the side car of a motor-cycle, operated by a marine orderly, and shortly indulged in a most exciting ride along the cliff road high above the sea. Once more the natural beauties of the coast were unfolded, this time however gazing toward the sea.

Finally after much rough riding, bumping and winding thru the combination woodland and rocky roads, the writer was startled to suddenly enter a cleared section and to observe a number of large buildings, tall masts and a bewildering network of antennae, loops and telegraph poles.

The entire reservation is surrounded by a high double barbed wire fence. The top wires of this enclosure are strung on insulators and during the war a potential of *several thousands volts* was constantly maintained.

A marine guard at the main gate greeted our arrival and after necessary military formalities we drew up before the Administration Building and were ushered before the officer in charge, Lieutenant S. V. Edwards, U. S. N. As the darkness was rapidly approaching, Lieutenant Edwards suggested awaiting until the following morning before an inspection of the reservation. Motion pictures were being shown in the recreation hall that evening for the amusement of the station crew off watch followed by an informal dance. The writer was agreeably surprised to note how complete were the facilities for recreation. With several pool tables, a tennis court, baseball teams and other sports, conducted by the athletic officer, the radio operator has little time for dull moments at Otter

Cliffs one is assured of that, at least.

After an excellent dinner, served by the station chef, and a real bath, the writer was conducted to a sleeping room most complete in its comforts, such as the best hotel could boast. The windows opened out over a steep embankment, down the coast toward several lighthouses, monotonously flashing through the night. A full moon added to the enchanting view and the writer was wooed to sleep by the swish of the surf on the rocks far below and the moan of the nearby pines.

Awakening early by the strains of a bugle sounding reveille, a magnificent view was enjoyed with the rising sun sparkling over the sea. The writer could hardly restrain himself with impatience and curiosity to examine the mysteries of the place. A bugle sounded call for breakfast and again the station chef did the honors.

It was noted that a strict military spirit prevailed over the place, and as the writer stept out upon the spacious porch of the Administration building, the bugler was sounding "colors" while all hands stood at attention during the hoisting of the flag to the masthead, followed immediately by "boat-call" when a truck quickly drew up before the porch awaiting orders from the officer of the day to proceed on its regular trip to Bar Harbor in much the same manner as occurs upon a warship at anchor in a river or bay near port.

From the porch of the Administration building, which is a former club house reconstructed by the government to serve for office purposes, officers' mess hall and sleeping quarters, the writer could observe several large buildings which were explained to him as being a recreation hall, crew's dormitory and mess hall, main operating room, marine guard barracks and several shacks far out in the field used as individual receiving booths, each employing an antenna of the loop type. Connection is made to each receiving booth by telegraph wire from the main operating room, adjoining the Administration building.

Closer inspection revealed the receiving loops and various methods of reception. Several types are in use, but all loops are absolutely *stationary*. Of course they are permanently arranged in the proper direction for best reception from the emanating point of the incoming signals. One type of loop which appeared rather unique was constructed from four ordinary telegraph poles spaced in pairs, about sixty feet apart and arranged with cross pieces at top and just above the ground. Upon these cross pieces were arranged ordinary telegraph glass insulators for securing the receiving wire. The proper spacing and number of wires in use were decided upon by previous experiments.

Another type was constructed from single telegraph poles about sixty feet apart with ordinary cross arms at the top as well as a few inches above the ground, upon which were several glass insulators with the wires looped thereon.

A cage loop was located in the field for the purpose of experiments and upon this loop by the way are being conducted extensive receiving tests on high speed reception. A similar loop is located near the main operating room on which is received signals from the Canal Zone and the West Indies.

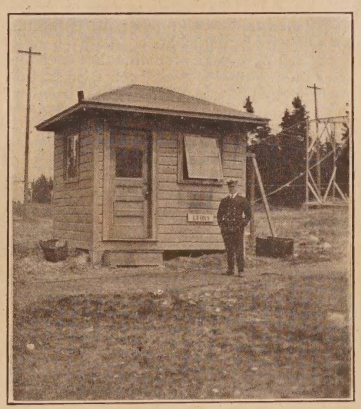
Some success has been obtained in reception of long distance signals upon a single wire laid carelessly upon the ground surface and extending one mile in each direction up and down the coast with the receiving apparatus located in the middle of the wire.

Each receiving loop and booth has been assigned a particular station to copy and a strict operating routine is observed. The Naval Communication Service depends upon Otter Cliffs for nearly all Atlantic reception and signals are copied from Germany, France, Norway, Italy, the West Indies and the Canal Zone. It is with regret that owing to the confidential policy of the Naval service the writer is unable to explain in detail the circuits employed at this station. It may be said, however, that signals are received from Europe and other long distance points with sufficient strength to allow an operator to copy upon a typewriter with perfect ease. No attempt is made to isolate the operator and the door and windows are left wide open. Should necessity require silence, the receiving rooms are so constructed as to be absolutely sound-proof.

Otter Cliffs is connected with Washington and other Naval communication points by leased telegraph lines. Commercial radio traffic is handled from Germany, Norway and France, and experience over several months of ever increasing volume of traffic has shown that the service is greatly appreciated by the various business interests who have obtained excellent results.

Much has been mentioned in recent lectures and publications of the exceptional signals at Otter Cliffs with an absence of atmospheric difficulties, and this fact was substantiated by the writer's visit. One explanation for this phenomena is perhaps due to the moist nature of the soil, as it is possible to locate water a few inches below the ground at most any spot on the reservation. A clear stretch toward the sea and the lack of high trees probably also aids reception. Of course, power plants, high structures and local strays caused by high tension generators are absolutely remote from this section of the country which is most desirable.

The two steel towers, nearly two hundred feet in height, are used for the reception of spark signals. The ship traffic, both official and commercial, is very heavy



Close-up View of One of the Field Receiving Booths; This One Being Designed to Receive Signals From Lyons, France. Mr. Cole, One of the Officers, Is Shown in the Foreground.

and a large volume of radio business is exchanged with the transatlantic liners. The spark transmitter for Otter Cliffs is located at Sea Wall, a distance of nine miles to the southwest. However, the operator controls the transmitter from Otter Cliffs by a remote control system.

Two radio compass stations are also operated from Otter Cliffs by remote control, and bearings are furnished vessels when requested. It will be noted in Fig. II. The unusual construction of the radio compass house, resembling a lighthouse, may be noted from the accompanying illustrations. The compass coil is inside the house about ten feet above the receiving instruments which are on the ground floor. A battery charging set as well as the batteries are located in a small out-house.

Considering the beautiful location of Otter Cliffs station and the unlimited means taken by the government for the welfare of the operators stationed there, it is doubtful whether a more pleasant duty could be secured in the whole radio world, Naval or commercial. Every effort has been made for the comfort of the personnel, excellent sleeping dormitories, meals fit for kings, and plenty of recreation while off duty. A completely equipped hospital with a Naval surgeon is attached to the station as well as a Naval dentist. The station paymaster conducts a commissary store, where food supplies may be purchased at cost. Married personnel are permitted to reside near the station.

The station consists of over one hundred officers and men, including marine guard, operators, electricians, cooks and other necessary specialists.

With the recently increased Naval pay and a generous allowance for shore duty the life of a Naval radio operator, especially at Otter Cliffs, looks rather inviting.

DO MOTHS USE RADIO WAVES?

Do moths use radio telegraphy?

This query is not nearly so grotesque as it may at first appear, says Hubert Stringer in *The London Daily Mail*. During the pairing season in the month of June moths of certain species are observed to communicate with each other over distances as great as one or two miles by some means unknown. A female vaporer moth, for instance, inclosed in a wooden pillbox, will attract males of its species from all directions.

Now, it is not by scent that the position of the female moth is discovered, since the males will approach down wind; neither can it be by a sound of some frequency inaudible to human ears, for a female may be inclosed in a sound-proof box and the males will still unerringly find her. Entomologists so far have shelved this mystery under the head of communication by some means unknown, and there in the textbooks the matter rests.

It is now high time that experiments were made upon the supposition that radio telegraphy may afford a solution. If this should prove to be the fact it will undoubtedly be found that electro-magnetic waves of exceedingly short wave length are employed. Now, light is an electro-magnetic wave of very short wave length; both glow worms and fireflies emit light under similar conditions, so there is nothing so very improbable in the emission of slightly longer, and hence invisible, waves by other insects.

Observed facts seem to lend color to the idea.

Moths have antennæ. These, besides acting as feelers, may serve another use—that of transmitting and receiving aerials. The antennæ of the female, who is the transmitter, differ in design from those of the male, who receives. Moreover, the male moth when approaching the female, is seen to alight often in an uncertain manner swinging his antennæ, much as an operator swings a radio direction finding frame to discover from what direction signals emanate.

Editor's Note: Let us hasten to apologize for this bit of radio humoresque. We blame it all on our English cousins. We can neither prove nor disprove the theory, as we really are not in the moth business. Our particular worry is confined to more potential insects —er, you know what we mean. They are sometimes called "radio bugs."

RATE CHANGES.

Beginning April 1, 1920, the rate for North and South American service and *transoceanic* service on all vessels operated and controlled by the Radio Corporation of America will be 4 cents per word.

On ship and coast stations operated and controlled by the International Radio Telegraph Co. there is no charge for relay traffic.

Radio in Germany

By R. WILHELMI

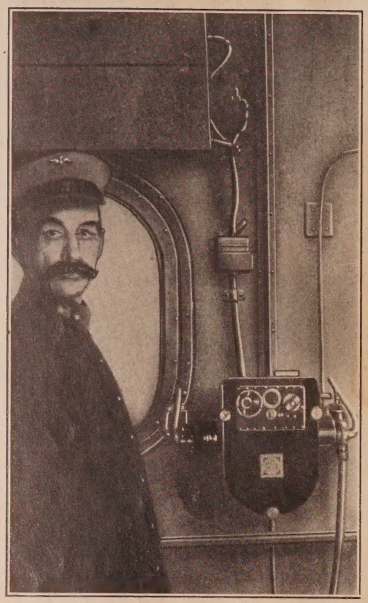


Fig. 2. This Apparatus Is Installed in the Cab of the Engine and by Means of Oral and Visual Signaling, the Engineer Is Informed Immediately When He Has Past His Block.

AS is well known radio telegraphy and telephony have always been subject to the rules of the German Post Office Department, and for that reason has not been developt to such an extent as in most other countries.

Thus, for instance, there is today in Holland a well-known amateur organization for radio telegraphy, having about 1,500 members. They hear regularly all the great European and Trans-Atlantic stations by means of their apparatus and exchange their experiences in one of their radio journals. It is to be regretted that no such thing is possible in Germany today where there are many thousands of ex-officers and soldiers who were attached to the radio telegraphic service during the war and who are not now in a position to have their own radio stations.

Recently a well-known German company has brought out a novel style of radio compass shown in one of the accompanying illustrations. As will be noted the direction finder is mounted on top of a wheel and inside of the frame a radio receiving outfit is placed. It becomes now possible to have a complete receiving station encompast into a weight of about 22 lbs. comprising antenna, receiving station and direction finder all in one, as shown in our illustration. Inasmuch as the outfit is very compact, and due to the fact that it can be easily rotated by means of the large wheel, it should find a ready market.

Where it was possible heretofore only to use radio telegraphy in such places where the use of wires was not practical, much progress has been made recently in the use of radio telephony and telegraphy, *using wires.*

As is well known, all signaling systems not only in Germany but throughout Europe are in a terrible condition today. All wires are overloaded to a very considerable degree, while new wires cannot be strung up due to the tremendous cost at the present time.

But it has been known for a long time that radio waves are propagated very readily along conductors of electricity, such as, for instance, rivers, rails and telegraph wires. This condition has lately been made use of to still further use the present loaded telegraph wires without in the least interfering with the traffic flow on the wires. The purpose of this wired wireless telegraph and telephone which in German is called "leitungsgerichtete" (conductor directed) radio telegraphy and telephony is that it becomes now possible to take a wire which heretofore could only be used for one conversation and implant upon it three further conversations, all simultaneously, simply by using three radio stations. The curious fact is that a subscriber now never knows if he is talking over the wire or by radio.

For the past year, the line Berlin-Hanover (280 kilometers) has been used in this fashion, and the experience has been so extraordinarily good, that by the time this appears in print, the new wired wireless will be in actual use between Berlin and Frankfort, which is a distance of 500 kilometers.

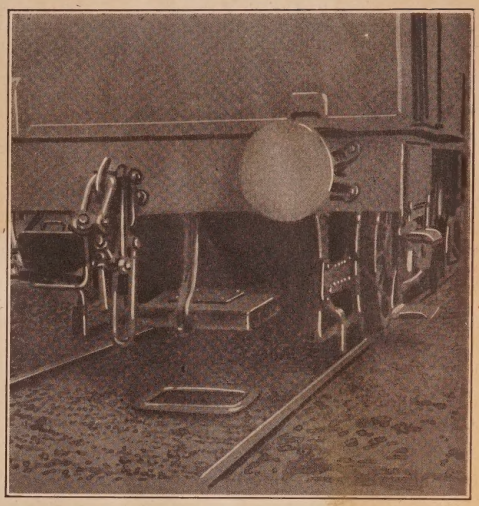


Fig. 3. The Ground Plate Bears an Inductive Relation to the One Fastened on Car Which Actuates a Signaling System When the Train Passes Certain Sections.

The German Government railways have also made use of this invention as is clearly shown in the enclosed illustrations. In order to safeguard the lines still further, and prevent accidents, the new wired wireless is being actually used in the trains to signal the engineer in the locomotive in the following manner. The installation comprises a small vacuum tube outfit stationed in the locomotive. between the rails, spaced in proportionate distances, we find small frames enclosed in water-tight material as shown in our illustration Fig. 3. The purpose of these frames is that when the locomotive passes over same due to the inductive relation between this frame and a similar one suspended from the locomotive as shown, the engineer of the locomotive can be informed immediately if he has past his block. There are two means to do this. One is an electric horn making considerable noise, the other electric signal lamps which may be seen in the oval case, the horn being at the left, the signaling lamps in the upper center. The system has worked very satisfactorily. and it actually has become possible to start and stop a train from a considerable distance.

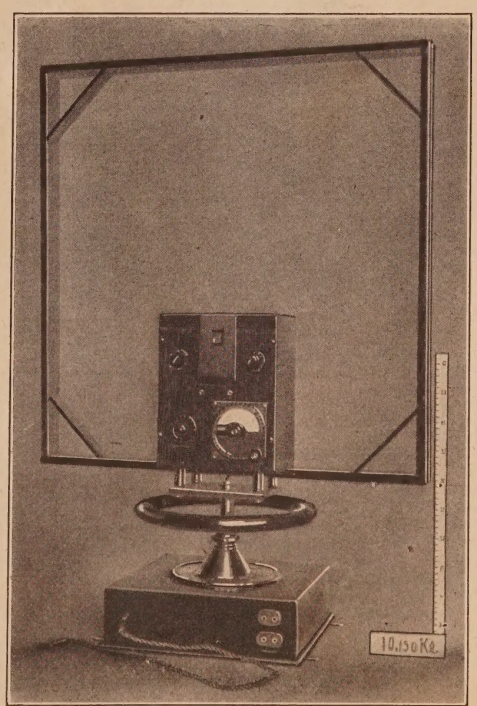


Fig. 1. This Radio Compass Comprises a Complete Receiving Set Encompast Within the Frame of the Loop. This Arrangement Makes a Very Compact Receiving System, Which Weighs About 22 Pounds.

(Abstracted from "Deutsche Export-Revue")

A RADIO DISTANCE RECORD.

First Amateur (rushing into laboratory of friend): "Hey, Bill, I sent a message over ten thousand miles!"

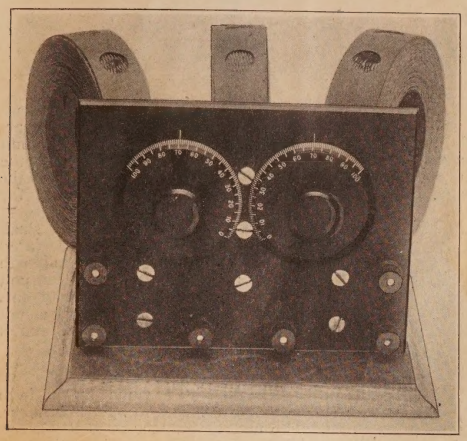
Second Amateur (excited): "How did you do it? With your new transformer?"

First Amateur: "Naw, with a two-cent stamp."

—PERRIN ADAIR.

ALFRED LOOM
Bellingham, Wash.

New Radio Apparatus*



Front View of the New Receiver Which Makes Use of the Duo-Lateral Coil Inductance.

FOR years previous to the war radio manufacturers had been trying to devise a receiver which would be at once compact, take up little room, be simple in operation, be pleasing to the eye, and above all be absolutely reliable and *efficient at all times.* Then war came and manufacturers were forced to lay aside amateur apparatus and devote their exclusive attention to the needs of war which included transmitters and receivers, whose only requirements were that they be simple of operation as well as efficient; all other conditions being temporarily overlooked; the main object being to turn out the apparatus in as short a time as possible.

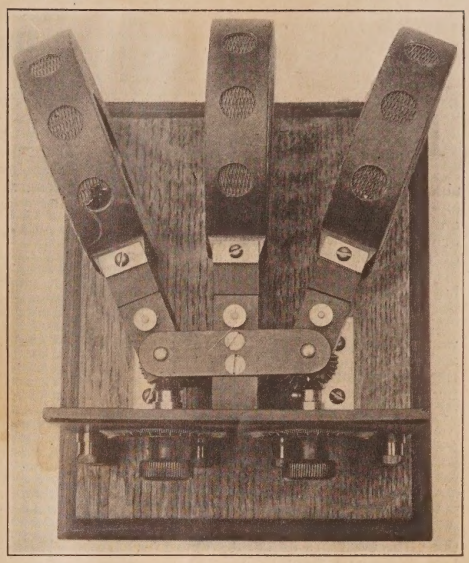
After the war there was, of course, an immediate change in prevailing conditions. The government was no longer in need of great numbers of instruments, *but the amateur was.* Of course we could not expect the ideal amateur instrument to be evolved immediately. Rather, it has been a matter of evolution. Many types of receivers have been constructed and sold. Considering the knowledge and experience at hand some of these instruments were excellent in workmanship and design but there was much room for improvement.

The above two photographs show two views of a receiver which is consistent with the above remarks and which is destined to become a popular instrument with the amateur. The designers have not only taken into consideration the present needs of the amateur but his future needs as well; that is to say the receiver of today must be so constructed so as to readily adapt itself to the radio conditions of tomorrow, barring of course the advent of some radical change of the radio we know at present.

The general construction details of this unique instrument may be briefly outlined as follows: The panel is made of bakelite and the gearings which are positive in operation and have a two to one ratio allow of very close coupling changes. The inductance coils, altho as may be seen, look somewhat like the honeycomb type, are of the *duo-lateral winding,* which is probably the most efficient radio inductance of today. This new inductance has the desirable qualities of having 15% less distributed capacity than similar coils, 12% more inductance as well as 7½% less high frequency resistance and natural period.

An important factor connected with this instrument is that great ease and facility is experienced in adjusting each inductance unit by means of the effective plug contacts which may be plugged in and out with certainty.

The arrangement of the instrument is such that the center inductance coil, which remains stationary, is employed as the secondary of the receiver; the coil to the left may be used as the primary inductance while the third coil, which is to the right, may be used as the tickler coil. Still another manner of using the instrument such as for instance the reception of undampt waves would be to employ a very small coil in the place of the tickler and connect this coil in series with an external oscillating circuit. In this manner the heterodyning of the incoming oscillations is made possible.



This Is What We Might Call a Bird's-eye or Top View of This Interesting Instrument Showing the Method of Gear Movement.

*Photographs by courtesy of The Pacent Electric Co.

LAND STATION LICENSES.

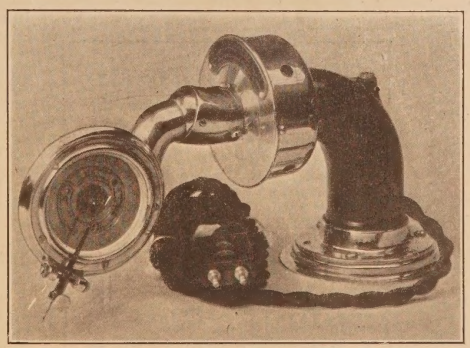
All commercial land stations, experimental and technical and training stations are required to obtain a license before operating a transmitter as required by Section 1 of the Act of August 13, 1912.

The filing of the application or the assignment of radio call letters does not constitute authority for operating a station.

Owners of stations who fail to comply with the above requirements may expect action to be taken in accordance with the above-cited act.

New Device for the Radiophone

A CALIFORNIA radio manufacturing company, well known for the great strides it has made in turning out sound-amplifying devices of many kinds, has just brought forth an interesting little instrument called *The Transmitter Tone-Arm* and which may be seen from the accompanying illustration. This instrument was primarily designed to reproduce and considerably amplify phonograph music. It can be screwed to the top board and otherwise attached to any make of the phonograph. In order to amplify phonograph music a six-volt battery is connected in the circuit and leads may be carried to a distant point to an arrangement known as the *Telemegaphone.* The interesting part of this instrument is that it may readily be adapted to any amateur radiophone transmitter set so that now that considerable attention is being paid "to music via radio," this device fills a distinct need, particularly to the snappy up-to-the-minute experimenter, who is ever on the hunt for something new. There is nothing complicated about the general construction of the Transmitter Tone-Arm. A regular sound reproducer with more than ordinary sensitiveness transmits the phonograph record sounds to a specially designed transmitter having four microphones connected in parallel. The total arrangement, of course, being fitted with universal joints, so that it may be moved to any angle or placed in any position on any sound box.



Place the Transmitter Tone-arm in One Corner of a Phonograph Box, Connect the Plug to Your Radiophone Circuit and Presto! You Have Music a la Ether Wave.

Design of a Radio Receiving Set

Part I

By L. M. CLEMENT

THE radio telegraph or telephone receiving sets which in fact are identical in construction, may afford one a great deal of pleasure and instruction. It is fascinating to be able to sit at one's radio set in the attic, or bedroom and listen to radio telephone and telegraph messages which have originated anywhere within a radius of several thousand miles.

Possibly a great many men and perhaps some women in non-technical lines of business would find the "Wireless Hobby" more fascinating were it possible for them to design and construct their equipment scientifically without the trouble of actually calculating the circuit constants.

It is the purpose of this article to present enough data in a handy form so that the average man will be able to design a successful radio receiving set to suit his particular needs.

What stations do you want to hear? Do you want to hear the ship stations, the amateurs or the high power long distance stations?

Radio stations are classified according to the wavelength they use in transmission. The available range of wavelengths is between 10 and 25,000 meters.

The Government uses exclusively the very short wavelengths and some interfleet and aircraft communication are carried on at 126 and from 80-120 meters, respectively.

WAVELENGTHS.

First it may be well to say a word or two about how the available wavelength scale, which includes the range of wavelengths from about 10 to 35,000 meters, is divided up and used.

The extremely short wave lengths, that is below 150 meters, are used exclusively for government work. Interfleet communication is carried on at a wave length of 126 meters while for some inter-aircraft communication wave lengths between 80 and 120 meters are used.

The experimental stations operate on wave lengths between 180 and 200 meters. The amateurs holding *special licenses* operate on wave lengths assigned to them by the Department of Commerce. Some of these stations are equipt with radio telephone apparatus and operate on wave lengths as long as 450 meters.

Submarine Chasers, some of the Destroyers, Battleships and Transports are equipt with radio telephone sets which operate on the wave lengths of 256, 297, 345, 400, and 600 meters.

General ship communication is carried on at 300 and 600 meters and other wave lengths which have been specially assigned by the Department of Commerce. Ships operating at these wave lengths use the ordinary spark systems.

Some vessels are equipt with the Poulsen Arc, Vacuum Tube or other undampt wave apparatus and operate on wave lengths up to about 4000 meters. Some of the Trans-Atlantic ships now equip with Vacuum Tube sets operate on a 2200 meter wave.

The stations of the Navy Department of the spark type operate on wave lengths up to about 3000 meters while the medium power arc stations (up to 50 kw) operate on wave lengths up to about 6000 meters.

The high power arc or alternator stations used for inter-Continental and trans-Oceanic work (100-1000 kw) use wave lengths between 6000 and 20,000 meters. There are stations of this type capable of being heard in any part of the United States, in England, France, Germany, Italy, Turkey and many other places.

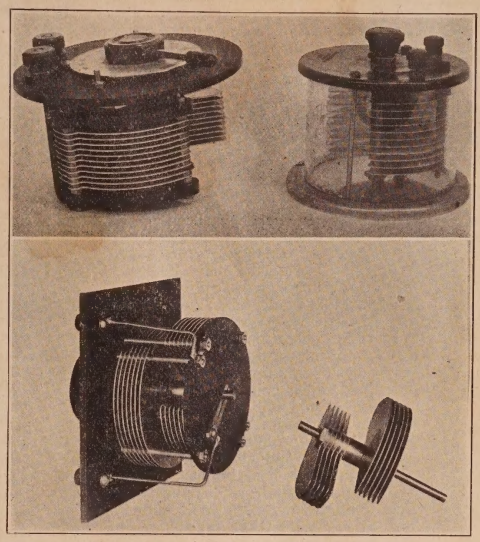


Fig. 5.—Illustrating Two Types of Variable Condensers Mentioned by Mr. Clement. Note Method of Plate Construction.

Do you want to hear the time signals? These are sent out at various times by a number of the naval radio stations. The Arlington Station sends time signals at noon and 10 P. M. Standard Eastern Time on their 100 kw spark station at 2500 meters.

Do you want to hear the spark stations, radio telephone stations, continuous wave stations or all of them?

What must you know in order to understand something about radio? There are five essentials which you will need to know something about, not more.

CAPACITY.

When a wire in a circuit is cut and the two ends do not touch, a capacity exists between the ends. If the wires are connected to plates, the same distance apart the capacity increases as the area. The unit of capacity is the farad. In radio work the micro-farad is generally used, because the farad is altogether too large a unit for practical work. 1,000,000, micro-farads = 1 farad. A convenient unit for small capacities is the micro-micro-farad (m. mfd.) meaning the one millionth part of a farad. This convenient unit will therefore be used thruout this article and care should be taken not to confuse it with the micro-farad (mfd.).

INDUCTANCE.

When a wire is wound in the form of a coil it is said to have inductance. The unit of inductance is the henry. The common units used in radio work are the mil henry, and the centimeter, 1,000,000 centimenters = 1 mil henry (M. H.), 1,000 m. h. = 1 henry.

WAVELENGTH.

Wavelength is a measure of the length of wave radiated by the radio station. It is measured in meters. 1 meter is equal to 3.3 feet.

TUNING.

Tuning is the ability of a circuit to respond to the desired wavelength more strongly than to any other wave.

COUPLING.

When the current in one circuit produces a current in a nearby circuit it is said to be coupled to it. The less the effect of this circuit on the other the less is the coupling.

There are a great many things which should be taken into consideration in the design of a radio receiving set, the reasons for which would take some time to explain. A few of these considerations will be mentioned in this article but no attempt will be made to explain the reasons for them.

You should not attempt to build a single receiving set to cover the entire range of wave lengths, but this should be done with no less than three sets of coils. The following ranges of wave lengths are suggested as being satisfactory:—50 to 400 meters, 300 to 3000 meters, 2000 to 20,000 meters.

How long and how high an antenna do you wish to erect?

The design of the receiver depends upon the wave length range to be covered and the antenna selected. Use a long antenna of high capacity for the longer wave lengths and a small antenna of low natural period for the shorter wave lengths. *The natural wave length of the antenna in no case should be greater than twice the lowest wave length to be received.* A number of different type of antennae which can be easily built by the experimenter is listed in Table I. The mechanical dimensions and electrical constants of these antenna systems are also given.

What condenser shall you buy to use with your antenna and receiver?

A list of a number of the available types of commercial condensers with their minimum and maximum capacities is shown in Table II. It is good practice to add a constant to the minimum capacity of the condenser to take care of the capacity of

The World's Greatest

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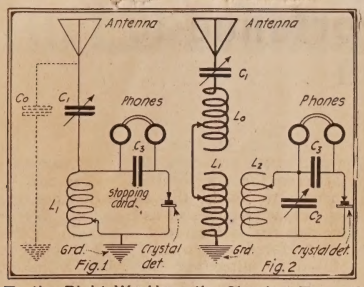
What will RADIO NEWS be five years hence?



To the Right We Have the Simplest Type of Receiving Circuit, While to the Left We Have a Much More Selective Arrangement.

the leads, capacity of the coil and capacity of the vacuum tube attached. For the type of coils referred to in this article and the ordinary vacuum tubes available in the open market this constant should be about 60 M. Mfds. Two types of variable condensers are illustrated in Fig. 5.

Will you start with the simplest circuit or do you prefer to use one of the types shown here?

The four types of circuits shown in figures 1, 2, 3 and 4 will meet the needs of the ordinary experimenter.

TABLE I

ANTENNA DATA

Mechanical Dimensions			Electrical Constants	
Length and No. of Wires	Length of Lead-in Wire Feet	Height in Feet	Natural Wave Length Meters	Static or Low Frequency Capacity M.M.fds.
"L" Antenna				
1—100	25	20	210	235
1—150	25	30	270	400
1—150	30	20	216	340
1—200	30	20	325	450
Umbrella Antenna				
6— 50	50	40	260	500
7— 75	90	80	570	1000
"T" Antenna with Lead in Center				
6—120	25	30	190	550

TABLE II

Electrical Constants of Standard Makes of Variable Air Condensers

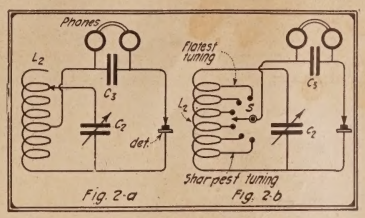
Manufacturer	Type No.	Minimum Capacity in M. Mfds.	Maximum Capacity in M. Mfds.
General Radio Co.	....	30	750
	....	40	1500
	....	65	3950
De Forrest Radio Tel. & Tel. Co.	....	50	500
Bletzen Condenser	....	25	900
Western Electric Co.	46A	40	825
	47A	25	225

The simplest type of circuit is illustrated in Figure 1. In this type of circuit the tuning is dependent upon the inductance of the coil and the capacity of the antenna as well as your tuning condenser in series. Incidently this is not strictly true because the antenna has some inductance but it is near enough for practical purposes when the wave length is large with respect to the natural period of the antenna. The resistance of the coil is in series with the resistance of the antenna circuit. When you add resistance to your circuit you make the tuning less sharp. This type of receiver is useful where sharpness of tuning can be sacrificed for simplicity of operation.

Will you use the crystal detector?

The crystal detectors using galena, radiocite, silicon, or a combination of bornite or chalco-pyrite and zincite are satisfactory for the reception of spark and telephone signals altho in general they are not so sensitive as a properly adjusted audion detector.

If you desire to get more selectivity than with the simple circuit just described, such a circuit is illustrated in Fig. 2. This is true because the resistance of the circuit L_2C_2 is only slightly more than the resistance of the coil and condenser and this can be made considerably less than the resistance of the circuit $C_0C_1L_1$. When the coupling between L_1 and L_2 is tight (coils placed close together with their axis parallel) the antenna reacts on the secondary

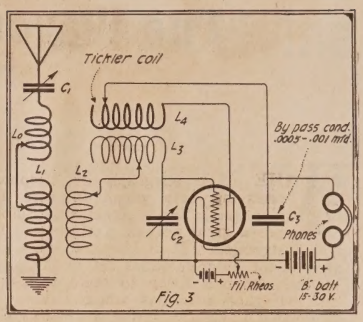


Two Methods of Improving Your Tuning to a Large Extent.

circuit and may be considered to introduce some resistance in it. The less the coupling the less will be this reaction and consequently the less the introduced resistance.

How can you obtain very sharp tuning with a crystal detector? What effect has the crystal on the tuning of the receiver?

The crystal detector has a resistance which is dependent upon the high frequency voltage upon it. The resistance decreases with an increase of voltage across the detector. This means that for large signals the condenser C_1 is shunted by a lower resistance than the normal value. This resistance causes a loss of power in the circuit and is equivalent to an added series resistance which flattens the tuning of the circuit. From this it is seen that for loud signals the condenser is shunted by a lower resistance than for the weak signals. See Fig. 2. Improve your tuning to a large extent by connecting the detector across a *portion* of the inductance L_1 as shown on Fig. 2a. This at once suggests the possibility of using a switch which will be capable of varying, to some extent, the degree of sharpness of tuning of the circuits. Such an arrangement is shown in Fig. 2b.



This Circuit Is a General One for Receiving Undampt Wave Signals.

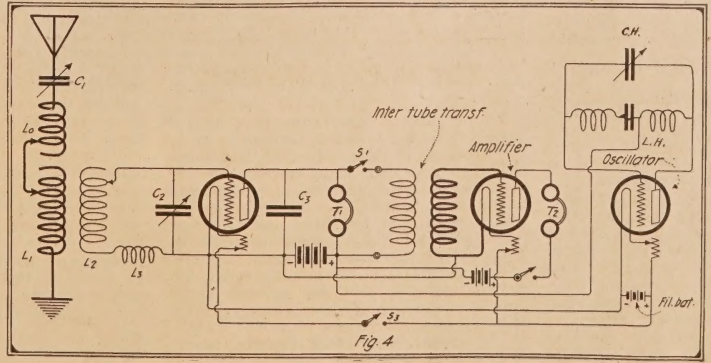
Do you want to be able to hear the undampt or continuous wave stations?

For the reception of these signals the vacuum tube is almost indispensable. The undampt wave signals are made audible by generating a second fresuency at the receiver which differs from the signal by a *convenient audible frequency* say 1000 cycles per second. One of the frequencies gains on the other and becomes in phase with it a number of times each second (in this case 1000 times each second). These beats are made audible after detection by the telephone receivers and appear as a tone of the beat frequency.

Which of the two general schemes for receiving the undampt wave signals will you use?

Two general methods are illustrated in Fig. 3 and 4. In the circuit Fig. 3, the local oscillations are generated in the circuit L_2C_2 and their frequency is determined by L_2 and C_2. The circuit formed by the antenna, $C_{1b}L_0$ and L_1, is tuned to the signal frequency which differs from tuning of the secondary circuit by the desired audio frequency. For the shorter wave lengths, that is, up to about 4000 meters the "feed back" method is satisfactory as the detuning of the secondary to produce beats is not great enough to cause serious trouble.

At the extremely long wave lengths say 20,000 meters the detuning of the secondary circuit to produce the 1000 cycle beat note is 6⅔% or enough to materially affect the strength of signal. (20,000 meters wave length is another way of saying 15,000 cycles per second).



In This System the Defect of the Self Oscillating Circuit Is Not Present. This Method of Connection Is Known As the External Oscillator Scheme.

Why is the external oscillator method of undampt wave reception best?

The defect of the self oscillating circuit is not present in the external oscillator scheme shown in Fig. 4. In this case the maximum signal voltage is impressed on the grid-filament circuit of the detector because the primary circuit (Antenna, $L_0L_1C_1$) and the secondary circuit ($L_2L_3C_2$) are tuned to the signal wave length. The local oscillations are supplied by an oscillator whose frequency is determined by L_hC_h and adjusted by the vari-

(*Continued on page* 60)

The Wavemeter and Its Importance in Radio Transmission

By YOSÉ

WHEN a radio experimenter uses a good wavemeter, he can do several things his less fortunate colleagues are barred from accomplishing.

He cannot do this, however, unless he has thoro understanding of the essential parts of the instrument. These parts are shown schematically in Fig. 1 and every one of them is a necessary unit, without which the wavemeter cannot operate properly.

In Fig. 1, L is a detachable coil, fitting the wavemeter at J in a clip or "jack." This detachable system of coils has some positive advantages, but promises to be displaced in the better instruments by a system of fixt inductances using the same wire over large ranges of wavelengths.

In the detachable system from two to six coils are usual. Each coil should be so made that it has a constant multiple of the inductance of the next smaller coil, i. e., every coil has between *four* and *sixteen* times the inductance of its smaller neighbor.

The condenser C is of the continuously variable type and its smaller condenser displacements are so related to the corresponding change in capacity in the first ten degrees of the scale that the tuning is kept from being too sharp in this range.

The better type of condensers for wavemeters now have their plates so shaped that a constant angular motion of say 10 degrees of the plate's changes—at *any* part of the scale—the total capacity by a *constant percentage*. This last improvement is an extension of the one mentioned just above.

The range of capacity in condensers is generally greater, the larger the condenser. It usually is found to be between four and fifty times the minimum capacity.

In Fig. 1, G is a current measuring device, indicating the strength of the oscillations in the instrument.

D is a crystal detector, shunting the head telephones T. This detector is joined by a connector W to the wavemeter wiring by a plug or a push switch at M.

The wavemeter is calibrated with the telephones *disconnected*, when used as a transmitter. When calibrated as a receiver, however, the telephones should be included in the circuit.

To actuate the wavemeter as a source of electrical oscillations, use is made of a buzzer Z actuated by a dry cell B connected at two external binding posts P & P'. The buzzer has a permanent connection to the wiring at R.

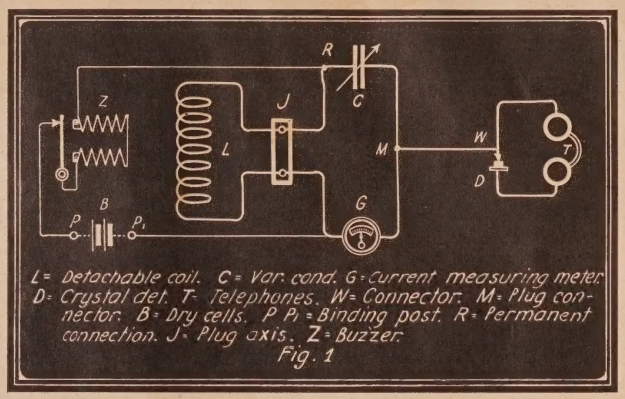
MOST IMPORTANT USE OF WAVEMETER.

There is nothing which is more important for the radio experimenter to know than that his transmitting station is giving out a single frequency wave with the greatest possible current in the antenna, but—"there's the rub!" Many amateurs are using three times the proper antenna current and getting poor results. Why?

Simply because they "jam" their coupling coils together to get high antenna readings.

These readings are not worth getting if they give broad tuning, yes! and even two frequencies!

The proper thing to do is to get a wavemeter and tighten the coupling *gradually*, just stopping *this side* of the point where the wavemeter shows "broadening' of the tuning. If the coupling were made still tighter, it would commence to show two tuning frequencies or "humps" in the usual phrase.



Schematic Diagram of the Wavemeter System Described by the Author.

The question naturally arises, does not the average experimenter find such a method too difficult to bother with? The answer is that recruits of seventeen years were taught to apply it with perfect satisfaction in less than one hour's instruction.

The principle used is simple. The telephones and buzzer connections are removed or opened and the wavemeter is gradually brought near the transmitter, but not nearer than three feet for a ½ K.W. transmitter and further away than that for higher powers. The precaution should be taken when a particular position of the condenser plates gives the maximum current in G, that this reading may be at the most sensitive position of the pointer in G. This is at about ⅓ full scale, usually giving the quickest action.

The essence of the method consists in tuning the transmitter, loosening the coupling, returning and then *increasing* the coupling, *keeping the reading on G constant*, with constant power in the transmitter. The last is very important! The power should preferably be absolutely constant for a minute, if possible, but *must* be constant for at least ten seconds, the time necessary to take an observation under this method.

The condenser plates are next moved each side of the resonant position to get a given "drop" in the position of the pointer of G. When this "drop" in G does not occur to the same reading as before until at least *twice* the previous detuning displacements are produced in C, then the tuning is getting *broad* and the coupling in the transmitter is just a shade too *tight*. Loosening it may not give the greatest range, but it will certainly give the greatest range *consistent with the purest radiation*. That is what every experimenter should want.

The procedure generally described above sounds more formidable than it really is, as will be seen by closely following the directions for making the test, given herewith.

PROCEDURE FOR TRANSMITTER ADJUSTMENT.

1. Adjust the transmitter to give steady power for 30 seconds, if possible, on the average, but at least for 10 seconds.

2. Test this condition of things by very loosely coupling the wavemeter to the transmitter and tuning same, watching the pointer in G for steadiness of deflection as the transmitter key is held down. This is *not a test for transmitter wavelength* or for real tuning which is accomplished as follows:

3. Uncouple the antenna circuit of the transmitter and measure the wavelength of the primary as follows:

4. Get the resonance point of the primary oscillation by selecting a coil L and coupling as above. When the condenser plates reach a certain position with some particular coil, the pointer in G will suddenly show a rapid deflection and suddenly resume its zero position if the motion of the condenser plates is continued even for a slight distance beyond the "resonant" point, marking the current rise.

Note: See that the coil L and not the condenser or wavemeter wiring is absorbing energy. This may be checked by rotating the coil L on its plug axis J, which procedure should vary the reading in G if coil L is doing its work properly.

The best way to observe the resonant point is to note and *take the average of* the two condenser plate displacements when the pointer in G reaches a value of say *one scale division less than* what looks like its maximum. This maximum is bound to be somewhat uncertain because the pointer moves very slowly at the greatest deflection. If the tuning becomes broad, as it *does*, when the transmitter coupling is just becoming too great, the pointer in G will move *still more slowly*. This will be treated in detail under "8."

5. Tune the antenna circuit to the primary circuit by changing the loading inductance of the former until the antenna ammeter shows a maximum.

6. Loosen the transmitter coupling and retune, proceeding in this way until two successive "retunings" show the same loading inductance.

7. The circuit is now ready to have its coupling tightened so as to get the closest possible coupling with pure tuning.

Bring the wavemeter up until the pointer of G is at about one-third scale displacement at "resonance."

8. Suppose that G reads about 30 scale divisions at resonance with C at almost 50 scale divisions (s.d.). Now move C either side of 50 until G reads 29. Perhaps these two points will be 48 and 51 s.d. on C. Their average is 49.5 which is more reliable than the above figure of 50 s.d., as an index of the wavelength in the transmitter oscillation.

9. Increase the coupling in the transmitter but keep G at 30 s.d. until the above difference of 3 s.d. in the readings of C is not 51-48 but say 53-46, or a scale interval

(*Continued on page* 34)

An Experimental Wave-Tester for Receiving

By RAYMOND EVANS

CAN you tune up to Lyons in a few minutes, or perhaps you can remember the adjustment for Nauen, Rome, Carnavon, Cavite or Funabashi, or would you rather have some definite means of quickly finding the necessary adjustment for the wavelength of any particular station?

Well then, just push in a plug, move a pointer to a position on the scale marked with the desired wavelength, press a button, adjust your receiving instrument to maximum signal strength, and listen to the desired station.

Or, perhaps you are wondering on what wave the unknown station you have just received, is sending.

Nothing easier when you have a wave tester cabinet on your station. All you require to do is to leave your receiver at the adjustment the station was heard on, and vary the elements of your wavetester until the maximum buzzer signal is heard in the receiver, when the wavelength can be *read off directly from the scale on your wavetester.*

Could we imagine a more desirable instrument to have on one's station when we think of the time usually taken up in groping about after apparently unknown and elusive wavelengths?

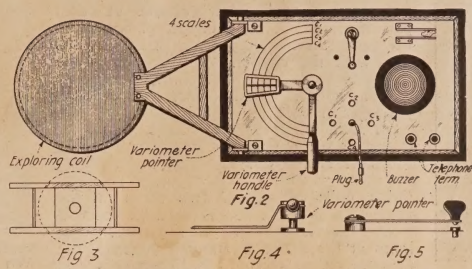
The wavetester eliminates all "groping". It is the devoted friend and servant of the experimenter as it is ready at a moment's notice to provide him with the correct adjustment for any particular wavelength, thus enabling the operator to carry out his experiments with more certainty, ease, and rapidity.

What is this interesting and useful instrument? It is merely a form of wavemeter, designed to be secured to the wall of the radio room, directly in front of the operator, where it will be easy of access, and ready to perform its duty when the occasion demands. In the wavetester, the subject of this article, the writer has devised a means of arranging a radio frequency circuit so that a very wide range of wavelength will be covered, and has also provided that the whole instrument is of the most simple construction, multivane variable condensers being eliminated.

As this instrument is intended for use on wavelengths lying between 150 and 20,000 meters, perhaps some difficulty will be experienced on the higher readings, in having it calibrated, but at least even these values can be obtained by careful measurement and calculation, which will be referred to later.

Referring to Fig. 1, L^1 is an exploring coil of fixt inductance value, L^2 is a source of constantly variable inductance or, in simple language, a variometer. C is a bank of condensers of the mica-tinfoil type, with a plug-in arrangement for adjustment of capacity, B is a tuned buzzer of high frequency and R its attendant shunt, D a carborundum crystal, clampt between the jaws of a suitable holder, P a telephone receiver, SW a three-point switch, one contact of which is lower than the rest, in order that switch can be used as a press-button if desired, and E a four-volt battery.

The reason for including the detector crystal and phones in the instrument is, so that same can be used as an ordinary wavemeter for tuning the transmitter should the occasion demand. The small switch would be placed in position 1 for the above test, but in positions 2 and 3, the detector circuit is cut out, and the exciter or buzzer circuit thrown in, in which condition the instrument is a miniature transmitter and therefore acts as a wavetester for the receiver.



These Are the Construction Details of the Experimental Wave-Tester Where Fig. 2 Is a Detailed Plan of the Instrument; Fig. 3, the Variometer; Fig. 4, the Pointer, and Fig. 5, the Switch

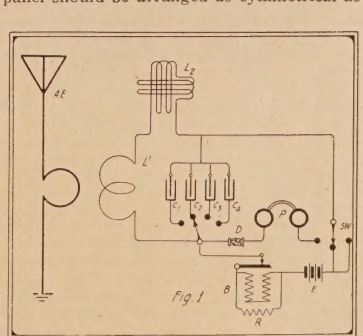
In the figure, the radio circuit is shown in heavy lines, and, of course, must be carefully built, in order to cut out resistance and distributed capacity effects. The variometer L^2 is composed of two coils, both of which are of very high inductive values, one arranged within the other and connected together in such a manner that when one (the inner) is moved axially within the other, a full 180°, the inductance varies over a range of from zero to the combined inductance of both coils.

This can be simply explained as follows, when at the zero value, both coils in series are in opposition and form a non-inductive winding, but when at the maximum position, both coils in series form one continuous winding in the same direction.

This variometer is used to indicate the wavelength of the circuit, being the variable member, but as the condenser values can also be adjusted, the value of the instrument as a wavetester is enhanced as its range is correspondingly increased with an increase of capacity in the circuit.

Four separate scales are provided on the variometer, each representing the wavelength, when that particular condenser unit is plugged in. For this reason, the scales should be marked C^1, C^2, C^3 and C^4 respectively.

The front panel for the wavetester measures 10 inches long and 6 inches high. It should be cut from sheet hard rubber or bakelite ¼ inch in thickness. The various units of the instrument should be secured to the back of this panel, so that it can be removed for examination or alteration at any time. The fittings on the front of the panel should be arranged as symmetrical as possible, preferably as in Fig. 2, and the bracket for the exploring coil made so that it can be swung around into place with a loop in the aerial lead as shown in Fig. 2. This method of placing the exploring coil, allows of a very wide variation of coupling which permits more accurate tuning.



Complete Wiring Diagram of the Instrument. All Parts Shown Are Fully Described in the Text

The panel, for the best appearance should be mounted to fit flush in a suitable wooden cabinet, fixt in a position on the wall which will be best found by experiment.

The variometer is shown in detail in Fig. 3, both coils should be wound on hard rubber formers, and spaced as in the "Morecroft" windings, or honeycomb coils could be purchased and used for the purpose, provided, of course, the correct values can be obtained.

The pointer for the variometer is made from 1/16 inch sheet brass and is provided with a mica window with a fine hair-line scribed exactly down its center. A long hard rubber handle is far better for our purpose than a round knob, the method of fixing to pointer being shown in Fig. 4.

The former for the exploring coil measures 8 inches in diameter and has a winding slot ¼ inch wide and ¼ inch deep cut in its outer edge. It should be turned from some close-grained wood and be given three coats of shellac varnish before winding. A small hard rubber block must also be provided for two small terminal posts for connection to the ends of the exploring coil. The bracket for this coil is also made of wood, well braced and rigid and pivoted to two brass fittings on the cabinet panel. The connections between the exploring coil and the instrument are made with a short length of rubber covered flexible wire of large current-carrying capacity. These leads are secured to the wooden supporting bracket by means of small cleats and are connected to terminals on the panel. The leads must not hang limp as the LC values may be altered in consequence, destroying the accuracy of the calibration.

The condenser units are all made with a dielectric of clear mica sheet .001 inch in thickness and tinfoil conductor plates. Each unit is placed between two pieces of hard rubber sheet and the whole condenser bank bound together with insulation tape and secured to the back of panel by means of a small brass bracket. Each unit is connected to a small brass plug socket made by drilling a hole centrally down through the head of a brass machine screw and then rounding off in the lathe.

The buzzer can be built or purchased, but in any case must be of the tuned type and have a shunt resistance of about 10 ohms.

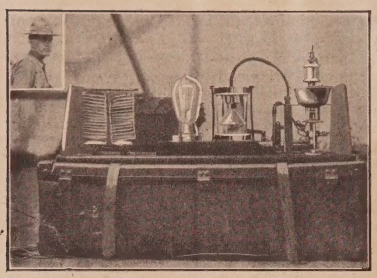
There are several makes of buzzers on the market at present which are fitted with shunts and the note of which has an extremely even and high pitch. Any of these would be admirable for use as an exciter for the wavetester. The buzzer is mounted on the panel itself as in this position it is easier of access should adjustment be required. The battery should be, for preference, a three-cell flashlamp (pocket) pattern. These usually give an EMF of about four volts and keep up well under normal conditions. It is secured inside the cabinet by means of a strap of brass and two screws.

Fig. 5 gives details of the three-way switch. The center contact stud is lower than the others as this allows of the switch being used as a press-button when desired. A small hard rubber handle or knob must be fitted to the switchblade. The crystal

(*Continued on page* 34)

AWARDS OF $100 RADIOPHONE PRIZE CONTEST

THIRD PRIZE WINNER



Photograph of the Complete Low Potential Arc Phone Set Constructed by Mr. Herreshoff

Low Potential Arc Phone

By N. G. Herreshoff, Jr.

THIS set operates on 110-v. D.C. The arc is enclosed in a glass tubular chamber, the kind used for sight feed oil cups with top and bottom ground for a tight joint. The positive copper terminal is drilled from the top with a 1/16" hole which allows the alcohol to pass thru the hot part of the copper, evaporating the alcohol, also aiding by cooling the copper. The copper has a groove near the lower end which catches the excess alcohol and prevents the liquid from reaching the end. The negative is an ordinary ½-inch arc light carbon.

The parts of the arc are easily removable by loosening two wing nuts on top. The arc is in series with the heating unit of an electric toaster also a piece of No. 36 copper wire 16 inches long which automatically strikes and regulates the arc gap.

The arc can be burnt either in an atmosphere of alcohol vapor or (due to the scarcity in these times of such liquid) in an atmosphere of hydrogen furnisht by the electrolytic generator which collects hydrogen bubbles from the negative wire that is immersed in the glass jar. The bubbles are caught by an inverted glass funnel which forces the gas into the arc chamber. Two or three drops of sulfuric acid or a little salt is added to make it an electrolyte. A small rubber tube is used to convey the gas from the generator to the arc chamber. When using this gas more or less violent explosions occur in the arc chamber while starting; but the bottom of the chamber is held in place by two small coil springs that allow the bottom to drop, thus relieving the pressure. The arc's output is much greater when operated in hydrogen but the arc is not as stable at this low voltage. A small pan of water cools the copper electrode by the evaporation of the water that is in contact with the copper. A few tablespoons of water will last for an hour.

The oscillation transformer shown in the photograph consists of "six turns of No. 12 D.C.C. magnet wire three inches in diameter for a primary and four hundred turns of No. 30 D.C.C. wound outside of the primary with a layer of paper between. Other coils of one or two turns on the primary and much fewer turns on the secondary work but on small aerials. The input at the mains is about 4 amperes, the primary circuit from 10 to 15 amperes, and the output from .22 to .50 amperes on a medium sized antenna.

The condenser is of the commercial telephone type of one micro-farad capacity made of alternate sheets of tinfoil and paraffined paper. A carbon grain microphone works best with about ¼ the amount of carbon used ordinarily. The D.P.D.T. switch shown in the photograph throws out the arc, changes over the aerial to the receiving set and lights the filament of the receiving valve. I have talked to two land stations in town as well as to two submarine chasers tied to a dock.

The greatest difficulty is to keep the arc from whistling. This can be obviated by keeping the electrodes free from pits and soot deposits, cleaning them with fine sand paper. When working at its best the arc gap is only about 1/32" long.

When using a condenser, two, three and four times the capacity of that given in the diagram, a proportionately greater current flows in this oscillating circuit but the whistling tone accompanies it with a lower and lower tone. However, with the capacity given in the sketch the arc is practically silent when regulated properly. The resistance which is of vital importance can be adjustable. The arc will not work properly when less than 2 or more than 5 amperes are used. A glowing resistance is preferable to a cooler type for as a short circuit is approached this resistance increases rapidly. A magnetic blowout applied to the arc is not practicable at this low voltage, a fact proven by actual test. The usual choke coils are used to prevent the oscillating current in the primary circuit from escaping into the feed wires.

It was found that when using the microphone in series with the ground the potential in the antenna cannot exceed two or three hundred volts or there will be arcing between the carbon grains which greatly distorts the speech, also causing the microphone to smoke. If a greater output is desired a few turns of the secondary coil near the ground lead-in can be tapped and shunted by the microphone giving good results. This method is used by the large arc stations. It is a good plan to have a small filament lamp of the flashlight type in the ground circuit for an ammeter as this indicates better than a meter the fluctuations caused by speech in the microphone. The slight blinking of this lamp is more rapid than the inertia of the indicator allows on an ammeter. This is important for it shows just when it is necessary to jar the microphone in order to bring new contact points of carbon together. The coils of the oscillation transformer must be coupled close and rather unlike those of higher frequency.

The arc regulating wire acting as the hot wire of an ammeter stretches when there is an increase of current in the feed circuit and this causes the carbon electrode to drop which has a tendency to keep the arc at its critical point. A fine wire is used so that the action is more rapid, due to greater cooling surface per area of cross section in a small wire, as compared to a large one. The right-angled lever for raising the carbon has a number of holes drilled in it through which the wire is fastened to the lever. This enables the fulcrum of the lever to be changed until the proper amount of motion is obtained. The other end of the wire goes to a ⅛-inch brass rod that is at right angles to the wire and serves as a drum for tightening the wire by turning a thumb screw on the other end. The drum is prevented from unwinding by applying friction to the two bearings that support the rod.

The complete set fits in an ordinary suit case for carrying it about. Fig. 1 shows the construction details of the arc proper, while Fig. 2 gives a diagram of the schematic hook-up for the combined instruments including necessary specifications and building data.

PRIZE WINNERS

First Prize $50.00 in Gold

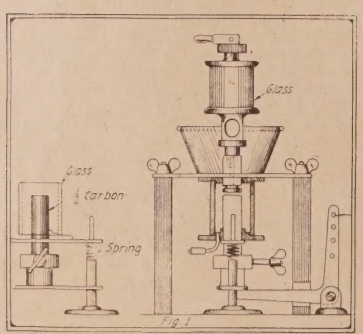
Mr. Herbert W. Harmon
Grove City College
Grove City, Pa.

Second Prize $25.00 in Gold

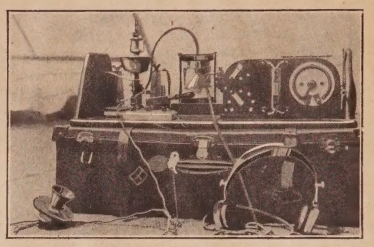
Lieut. W. L. Winner
General Hospital No. 2
Ft. McHenry, Md.

Third Prize $15.00 in Gold

Mr. N. G. Herreshoff, Jr.
149 High St.,
Bristol, R. I.



This Illustration Shows Some of the Construction Details of the Arc and Chamber Proper



Another Photograph of This Unique Set Which, as May Be Seen, Readily Fits Within an Ordinary Suitcase

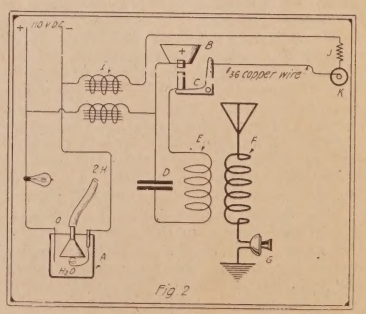


Diagram of the Schematic Hook-up for the Combined Instruments

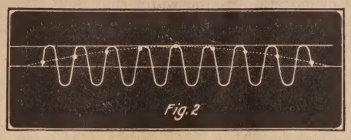
Musical Reception With Continuous Waves Without Local Oscillations

By DR. L. W. AUSTIN*

THE principle of what is now known as the slipping contact detector or ticker, was first applied to the detection of direct currents with the telephone by the author in 1900[1] and later applied to the reception of radio signals in 1906[2].

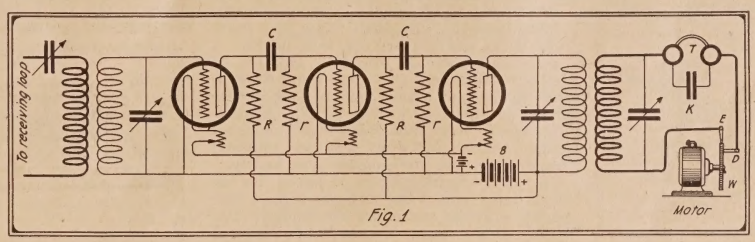
..This does not in general give a musical note in reception either for dampt or continuous oscillation, on account of the irregularity of the contacts. If, however, a toothed wheel or any equivalent contact maker, such as is shown in figure 1, be provided with a brush bearing on the face of the wheel or axle in such a way as to produce a steady contact, while a second brush is adjusted so as to touch the teeth, musical reception can be obtained with continuous oscillations. For this purpose the alternating E.M.F. is imprest at DE and the wheel rotated at such a speed that the contacts of the brush E are made with the teeth at a frequency a little greater or less than the frequency of the applied voltage. Under these conditions an alternating current will flow in the telephones of a frequency equal to the difference in frequencies of the contacts and the applied E.M.F. The process is shown in figure 2 where the dots represent the contact points and the broken line, the telephone current, the ripples being smoothed out by the reactance of the telephones. The resulting tone is not strictly a beat tone, altho the result is exactly the same as tho true beats had been produced. This device produces musical continuous wave reception by mechanical instead of by electrical means as in the Fessenden heterodyne.

In 1913, R. Goldsmith devised the first practical application of this principle in his tone wheel (U. S. Patent No. 1087113, Feb. 17, 1914), altho the circuits shown in the patent were somewhat more complicated. It was used for some time with the simple circuit described above, both at Arlington and Tuckerton in 1914. While entirely successful as a receiver in long distance continuous wave communication, it was less sensitive and less adaptable than the oscillating vacuum tube introduced in 1914 and was, therefore, generally superseded by it.



In This Illustration, the Heavy White Dots Represent the Contact Points, While the Dotted Line Represents the Telephone Current; the Ripples Being Smoothed Out by the Reactance of the Telephones

Recently the Research Laboratory has again taken up the study of the simplified tone wheel or musical contact maker which was interrupted in 1914, the object of the present work being the determination of its sensibility, the law of response, and its general applicability to modern receiving conditions, especially with amplifiers.



Circuit Diagram of the Radio Frequency Amplifier System Described by the Author. On the Extreme Right of This Illustration Is Shown the Schematic Arrangement Employing a Tone Wheel

The contact maker used in the experiments (figure 1) was an old tone wheel having a steel disk about 28 cm. in diameter and 754 teeth (with brushes arranged as described above). With this a contact frequency corresponding to a wave length of 10,000 meters is obtained at a speed of approximately 240 R. P. M., the power consumed by the motor being about 1/10 H.P. In order to reduce disturbances in the telephones, the steel disk was insulated from the motor, and the frame connected to ground. With the motor run from a storage battery no trouble was experienced in keeping a practically constant speed with which the European stations could be read for hours at a time without speed adjustment. For unsteady sources of power, a speed regulator is of course required. The telephones employed were Baldwin's of 2000 ohms resistance. Figure 1 shows the circuits employed with radio frequency amplification.

Comparisons of the sensibility of the oscillating vacuum tube and tone wheel without amplification were made on Annapolis changing the strength of the signal from 10 audibility to several thousand by inserting resistance in the receiving loop, and also in some experiments by varying the main capacity. The results were as follows:

(1) The sensibility of the tone wheel without amplification varies from 1/6 to 1/3 of the sensibility of the oscillating vacuum tube, depending upon the tone and brush adjustment.

(2) The law of response between telephone current and radio frequency current is linear as in the oscillating vacuum tube. The tone wheel has, therefore, all the advantages of the latter in keeping out interference and static. In fact, it seems somewhat superior in keeping out strong interference.

(3) It may be used either with radio or audio frequency amplifiers. Radio frequency amplification is in general to be preferred on account of possible induction brush noise.

(4) While less adaptable to wave length changing than the vacuum tube, this could be accomplished for predetermined wave lengths by a set of automatic speed regulators.

(5) The brush action would probably be improved by filling in the spaces between the teeth of the wheel with insulating material so as to present a smooth surface to the brush.—*Journal of the Washington Academy of Sciences.*

* *U. S. Naval Radio Research Laboratory.*

[1] Phys. Rev. 11. Aug., 1900.
This Journal 1:6, 1911. Physik Zeitsch 12:867, 1911.

"RADIO NEWS"

WITH this issue we change the name of your publication from RADIO AMATEUR NEWS to the RADIO NEWS. This change is not being made simply because we think it sounds better, but is the result of carefully compiled data. Last year we printed in a number of issues some voting blanks asking our readers what preference they had between the names of RADIO AMATEUR NEWS and RADIO NEWS. The final result of this vote showed that there are about 7,000 readers out of 10,000, who preferred the name of RADIO NEWS. It was this overwhelming vote which decided the change of name. The mission of RADIO NEWS is twofold. In order that you fully understand our meaning let us analyse the two words *radio* and *news* thusly:

"Radio" means at once one of the most fascinating, instructive, and we may say profitable pastimes of the century, and for that reason needs no further introduction. As for the word "news" this means that everything connected with radio which is of general interest to the amateur, the professional and the embryo student has been gleaned from the *four corners of the earth* and placed before you. The word N.E.W.S, therefore, indicates in a most striking manner the four points of the compass, in other words, north, east, west and south. Perhaps it is a coincidence but it looks very much as if the originator of the word wished to introduce these four points so that the word fittingly represent its purpose.

Another reason for abolishing the word "amateur" is that by its use professionals infer that the magazine is meant solely for that one class of individuals whereby one may readily see by glancing through any typical issue that the field covered is a wide one and certainly not restricted in its mission. Furthermore, and judging from letters received from our amateur friends, this class of enterprising young men do not wish to be branded by any traffic names which confine them solely to one class or body of experimenters. Again, radio offers too many possibilities to the average young man to cause him to remain an amateur. It is rather a process of development where the student starts out with tuning coil crystal detector, and twenty-five foot aerial and from that time on, slowly but surely climbs the ladder of this interesting science until he has reached the pinnacle of professional radio operating or engineering. For that reason, the purpose of RADIO NEWS may be said to prepare the novice and the amateur for the serious purpose of eventually having him step into the ranks of the professional, and having once reached there keep him informed and up-to-date on interesting events and development of the art. If we are able to do this, we shall consider our duty well done indeed.

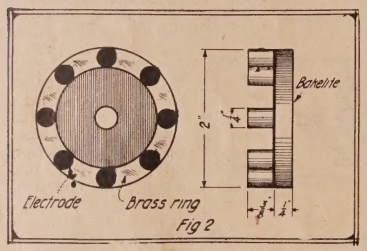
THE RADIO CONSTRUCTOR

A Synchronized Commutator Spark Coil Set

By NAT SAUBERMAN

THE advantages of a musical note in Radio need not be dwelt upon. Nine amateurs out of ten ignore fundamental principles of transmission with the subsequent result of poor efficiency and a great deal of interference. With a little care and patience a synchronized commutator set may be built which will improve the range of your station to a great extent. If you already have a 2" spark coil, spark gap, condensers, and oscillation transformer, all that is necessary to be built is the commutator, a stand to hold the brushes and the rotor for the spark gap. A small six volt battery motor is also necessary and can be bought very cheaply.

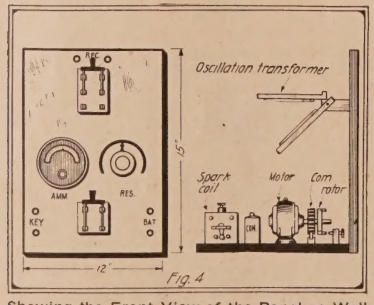
The commutator is made in the following manner: Procure a disc of bakelite 2" in diameter and 1" in thickness. Divide it up into 16 sections by drawing the perpendicular diameters and subdividing them. You will then find that each section is 3/8" wide. Cut 8 pieces out of a sheet of copper foil each 3/8" wide and 1½" long. These are to be used as segments. File each alternate section of the bakelite so that the copper foil will fit in snugly and be flush with the top.



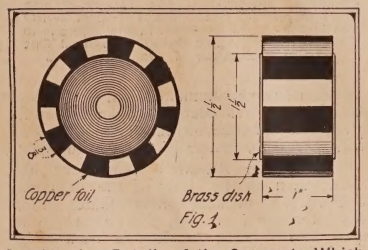
Construction Details of the Eight Electrodes Which Are Made With Ordinary Zinc Rods

Fasten the segments to the bakelite with shellac, leaving a half inch protruding on each side, which is held to the bakelite with 2 brass discs, and are in turn fastened with shellac, Fig. 1.

The commutator may be mounted on the shaft of your motor or may be belt driven. If it is mounted on the motor it will be necessary to prolong the shaft. This can be done in various ways, and must be left



Showing the Front View of the Panel as Well as Manner of Arranging the Various Parts on base

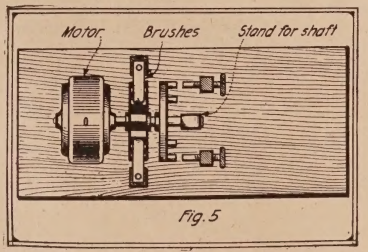


Construction Details of the Segments Which Are Fastened to the Bakelite Form by Means of Shellac

to the ingenuity and circumstances of the constructor. Care should be taken that the commutator be insulated from the shaft. The stand and brushes are next made.

Obtain a piece of wood or bakelite of sufficient thickness the dimensions depending upon your battery motor and cut to shape as indicated in Fig. 3. The brushes are made from two pieces of phosphor bronze each ½" wide and of sufficient length to touch the commutator lightly.

A rotary spark gap is required for an interrupter set. Your fixt gap can be converted into the stationary electrodes. The rotor should have the same number of electrodes as there are segments on the commutator. Obtain another piece of bakelite 2" in diameter and divide it up into 8 sections. The electrodes are each 3/8"



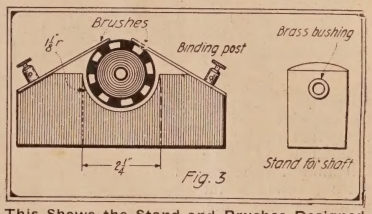
Top View, Showing Relative Positions of Motor Commutator and Spark Gap

long and may be cut from an ordinary battery zinc rod.

They must then be drilled and tapt. Fasten a ring of brass or copper 2" in diameter to the bakelite and mount the eight electrodes, Fig. 2. The rotor is also mounted on the same shaft as the commutator with lock nuts to hold it tightly. If you find the shaft of your motor a bit wobbly while revolving a simple stand can be constructed as shown in Fig. 3-B.

After having completed the construction of all parts, connect up the apparatus as shown in Fig. 6. The vibrator of the spark coil is not used. It can either be disconnected or tightened to such an extent that it will not vibrate. Start the motor and get the rotor of the spark gap in synchronism with the commutator. This is done by turning the relative position of the commutator to that of the rotor until a spark is obtained. To prevent excessive sparking at the commutator a condenser of about 2 microfarads capacity is shunted across the brushes. Excellent results can be had with a field resistance in series with the motor. By varying the speed of the motor any desired frequency can be obtained. However, for the best all around use the 240 spark note is preferable.

It is advisable to combine the apparatus and construct a panel of wood or bakelite. Fig. 4 shows the front view of the panel as well as manner of arranging the apparatus. It contains a D.P.D.T. switch for sending and receiving, a D.P.S.T. switch to start the motor, a hot-wire ammeter and the field resistance. The two binding posts at the top of the panel are for the receiving set, the two at the left for the key and the two at the right for the battery which operates the spark coil. Mounted behind

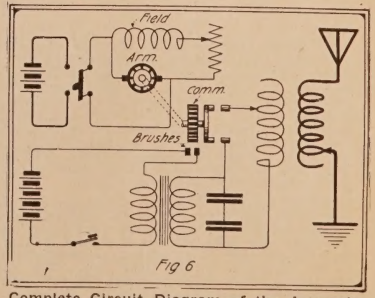


This Shows the Stand and Brushes Designed to Receive the Commutator

the panel is the oscillation transformer, condensers, spark coil and interrupter.

Fig. 5 shows the base upon which has been mounted the motor, the make-and-break commutator as well as the rotary spark gap. As will be noted these three instruments are mechanically connected as one unit.

If a little time and effort is taken in constructing this set any amateur can justly be proud of owning it as excellent results will be obtained, employing spark coils giving up to possibly a 3" spark. Personally I am very enthusiastic over the one that I have built. For those who are a bit skeptical I would recommend that they listen in for 2 ABJ (N. Y. C.). I am confident that all doubts will be dispelled. I will be glad to offer personally any information or suggestions to those who intend building a set of this kind.



Complete Circuit Diagram of the Apparatus Comprising the Induction Coil, Commutator, Spark Gap and Motor

...ion of a Magnetic Aerial Switch

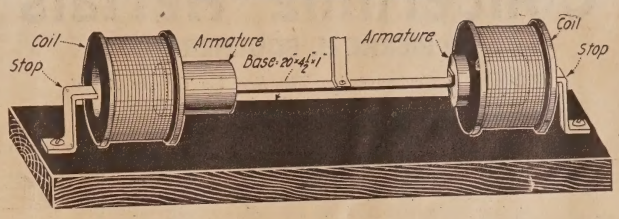
...D LOOP.
Bellingham, Wash.

By HERBERT WEBB

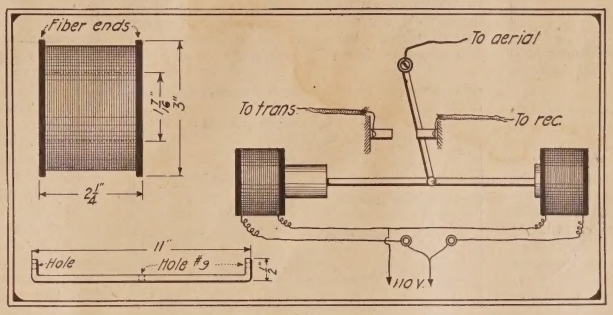
THERE are many advantages in a magnetic aerial switch. First, it is much easier to operate, working by the mere pressing of a button. Second, it admits of remote control of a sending station, which is very desirable in a sensitive receiving station. And third, it gives a commercial appearance to the station which is not to be overlooked.

The principle of operation of the switch thrower is as follows: There are two solenoids which are mounted on a base, with their cores connected by a rod of steel. When one of the buttons is pressed the core of one of the solenoids is pulled in and at the same time pulling the other solenoid core out. The aerial switch is attached to the rod which connects the two cores, or armatures. Then when the other button is prest the current is run into the other coil, causing the rod and the two armatures to be returned to their first positions. This moves the aerial switch back.

After having explained the operation the next thing is the construction. The base of the instrument must be around 1" x 4½" x 20". The armatures are made of soft iron preferably, altho I made mine of machine steel and they worked quite well, but I suppose that this was on account of the fact that I used A.C. to operate it and they didn't become magnetized. The armatures are made of pieces of round rod 1½" in diameter and 2¼" long. These are drilled in the diametric center with a No. 23 drill and tapped for 10/24 thread. Or they may be drilled with a No. 20 drill and tapped for 10/32 thread. I did the former.



Here Is a Perspective Sketch of the Magnetic Aerial Switch Described by Mr. Webb, and Which May Be Used to Excellent Advantage



Construction Details of the Various Parts Which Enter Into the Construction of This Interesting Instrument.

The rod that connects the two armatures is made of a piece of steel strip ⅛" x ½" and is 12" long. Drill the holes before bending. The holes are about No. 9, to accommodate the 10/24 screw. One hole is drilled in each end of the piece and one in the middle. The ends may then be bent up to receive armatures.

Next come the coils. A tube of brass, preferably, is used for the inside. Then two ends for each coil are made out of fiber, about 1/16" thick. They are 3" in diameter. The coils are then wound full of No. 22 or No. 23 SCC wire. The parts are then mounted on the base, using strips of brass to fasten the coils down. The coils will need some adjusting before they will be in exact alignment. This is done by loosening the strips and moving the coils in the right direction. When the strips are tightened up again they will be held securely. The connecting rod is fastened to the armatures with screws. The coils are, of course, fastened to the base in such a way that when one armature is inside its coil, the other armature is out. The wiring for the push buttons is shown in the diagram. As there must be something to keep the armatures from sliding all the way through the coils, stops are mounted on the base to do this. It may be just a strip fastened to the base with a wood screw shown in top sketch.

The instrument is then fastened to the aerial switch by an arm connected to the middle hole of the sliding rod. The switch may be of the kind that works with an up and down motion, as made by a Chelsea, Massachusetts company, or a switch described by Mr. E. T. Jones in the September issue may be arranged to operate with this device.

(*Continued on page* 36)

An International Alphabet

By GEORGE ANSTON

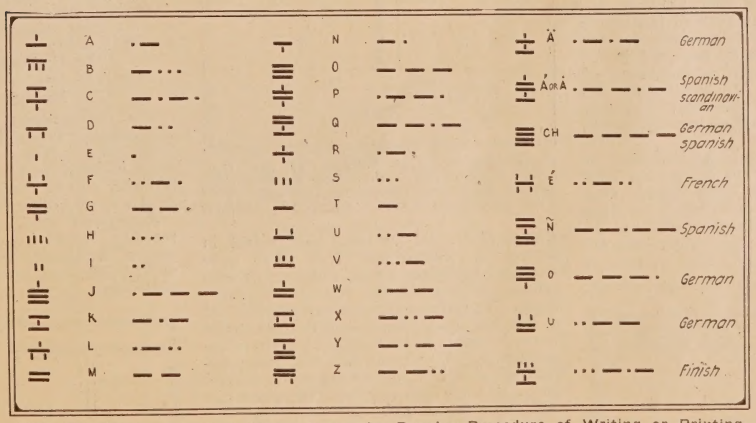
Editor's Note: It would not be a bad idea for technical printers to have these characters on hand for the regular dots and dashes do not look well on paper, and beside take up considerable space. These characters could be cast in type so that they need not take any more space than regular letters of the alphabet.

HERE is a method to enable us to print, read and write the International Morse Signal Code for international communication and international correspondence.

In this method the dot is represented by a short vertical dash and the dash by a short horizontal dash. Where the dot precedes the dash, like in the letter A, then we place a vertical dash above the horizontal dash of the letter A, and if there is more than one dot preceding the dash, say like the letter V, then we put just as many vertical dashes, over the horizontal dash, as there are dots in the letter.

Where dot succeeds the dash, like in the letter N, then we place a vertical dash under the horizontal dash of letter N, and if there are more than one dot following the dash, say like letter B, then we put just as many vertical dashes under the horizontal dash as there are dots in the letter.

Where dash succeeds dash, like letter M, then we place one dash under the other. We do the same for letter O, (*Con't on page* 36)

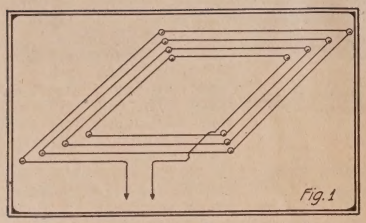


This Telegraphic Alphabet Differs From the Regular Procedure of Writing or Printing Telegraphic Characters in That They Are Simpler, Take Up Less Space, and May Be Written With Pen or Pencil at a Much Greater Speed Than the Old Way

Concerning Aerials

By PIERRE H. BOUCHERON

If You Are Contemplating The Erection Of An Aerial, Read the Following Remarks Bearing On Various Types



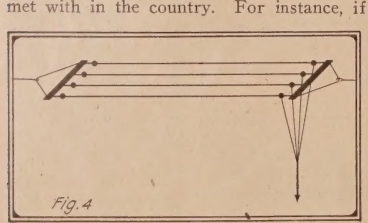
General Outline of Loop Type Aerial Suitable for Inside Work

OUR underground antennae experts have recently been telling us so much about the merits of various underground systems that for a spell it looked very much as if the familiar "top piece" was doomed to extinction. By the way, there is a rumor that a good book will shortly be publisht describing to the amateur the whys-and-wherefores of the underground antenna. If we ever have another war our Government radio sleuths will spend some interesting days trying to locate the forbidden aerials. Instead of climbing to the top of fifty-story buildings and sweeping the horizon with their mighty glasses in search of overhead wires, they will have to transfer the procedure to ground "sniffing" and possibly train a "ground hog" or two to ferret out hidden aerials.

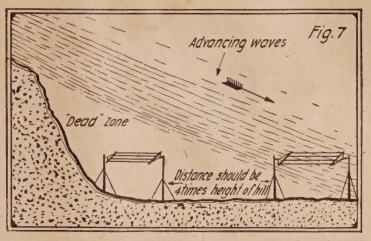
Meanwhile, however, there is no great fear that the underground antenna is going to replace the overhead one—at least not for a few years to come; for it is not every beginner who has the money or facilities for maintaining a two to six step amplifier necessary to secure the same results accomplisht by an overhead aerial and a one or two step amplifier. But let us return to our mutton.

This article is not intended to instruct the advanced experimenter whose years of experience in the amateur field has taught him just what to do and just what to avoid in the selection of an aerial suitable for amateur transmission and reception or for trans-oceanic long wave work. It is meant rather, for the constantly increasing hordes of boys and young men who are daily entering the most fascinating and instructive pastime of all ages. It is also intended for Mr. Adult who frequently has read in the newspapers of the radio achievements of youngsters, and who, forthwith, has decided to take to the radio shack now that the corner "G. M." has been converted into an ice cream parlor.

There are two general considerations to be taken into account to the person contemplating the erection of an aerial. One has to do with the city dweller and the other with the country or suburban resident. In other words, the city offers objections not met with in the country. For instance, if you are living in a large apartment house it is not always practicable to erect an efficient antenna, particularly if you are accursed with a profiteering landlord who, when approached on the subject, will inform you that the fire underwriters won't stand for "these here wireless thingum-a-jigs." If his heart cannot be softened by tactful explanations you will probably have to resort to an indoor aerial which will do quite well for receiving and short distance transmitting. Here is the description of one suitable for this purpose.



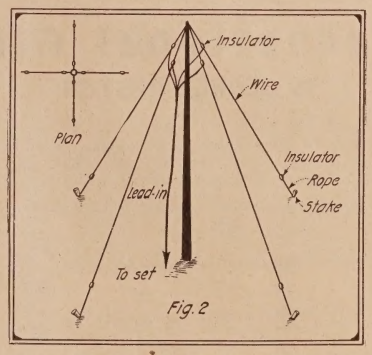
In This Sketch, We Have the Inverted L Antenna, Which Is a Very Effective Type and One Frequently Used



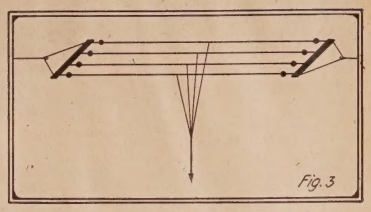
It Is Considered Bad Practice to Erect an Aerial Near or at the Base of a Hill, Owing to the Curving or Bending Effect of the Radiated Waves

AN INDOOR AERIAL.

The writer once lived in a Brooklyn boarding house presided over by the typical "hard-boiled" madam. Upon asking the lady permission to run a *little wire* up the side of the house to the roof it was gracefully refused. He was, nevertheless, *determined* to erect some sort of an aerial. Fortunately the room was a large, somewhat square, old-fashioned 25x20 feet in dimension. Accordingly four wires were stretched at the top of the walls next to the ceiling and around the four sides of the room. The arrangement was somewhat of a flat top loop effect and the two ends were brought down to the receiving instruments. The wire in this case was practically invisible, as it was composed of No. 20 S. C. C., which matched the white calsomine of the ceiling.



Illustrating General Scheme of the Umbrella Type Aerial, Which May Be Employed Where Spanning Space Is Limited. This Type, However, Is Not a Very Good Radiator

The lead-ins were brought down to the receiving instruments enclosed in a small desk so that the set was absolutely invisible. Altho this improvised loop arrangement gave excellent results without the use of a ground, nevertheless, one was obtained from the water pipe at the washstand. In this way several combination hook-ups were possible which produced very interesting experiments. Later the writer grew bolder and carefully insulated the over-head wires and small porcelain insulators and the aerial was used for transmitting purposes with a small spark coil whereby distances up to five miles were easily covered. Of course, the water pipe ground was used in this transmitting circuit, as it was found that the aerial radiated very poorly when used in loop fashion. Fig. 1 shows a diagrammatical sketch of the indoor aerial mentioned here. The reader, of course, will understand that he does not have to resort to this particular type. He may string up a regular L type aerial across the room near the ceiling, composed of at least six wires, particularly if the room is a small one. Indoor aerials of any type do not require much insulation when used solely for reception work, as there is no need for it, since there is no possibility of leakage due to rain or moisture.

Illustrating the T Aerial, So Called Because It Has the General Shape of the Letter T

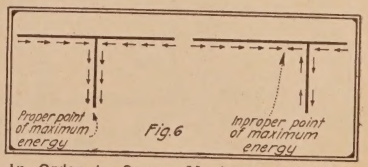
In general, indoor aerials are naturally not as efficient as the outdoor type, particularly when they are erected in or near steel buildings where the metal super-structure, steam, gas and water pipe system branching out in various parts of the house have a tendency to absorb transmitted or received energy.

REGULAR OUTDOOR AERIALS.

Before we proceed further upon this subject we will indulge in a brief discussion concerning the fundamental characteristics of various types of aerials. We shall, however, confine ourselves to three general kinds; namely:

The Umbrella Aerial.
The so-called T Aerial
The inverted L Aerial.

The experimenter may choose the one particularly adapted to his needs or limitations. For instance, if he has very little space in which to span it, the umbrella type probably will be the most effective, see Fig. 2. If, on the other hand, he has plenty of "elbow room" the T aerial may be adopted, see Fig. 3. If he is seeking general all around satisfaction or wishes to secure an exceedingly long span in order to receive long wave European stations, the inverted



In Order to Secure Maximum Efficiency, Lead-ins of T Aerials Should Be Connected at the Exact Center and Not Slightly to the Side

L is the proper type to resort to, see Fig. 4. In fact, it may be said that the latter is the one most commonly employed, as it is effective, simple of construction and presents a good appearance. Incidentally it is also the one mostly used for shipboard.

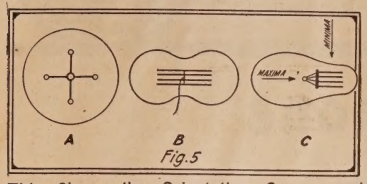


Fig. 5

This Shows the Orientation Curves and Illustrates the Directive Qualities of the Umbrella, T and L Types of Antenna

Another factor to take into consideration is the directive effect of each type. If you have in mind the transmission or reception to or from a certain known station, or of general directions such as those facing Europe, South America or Asia, you will probably wish to align your aerial so that it will pick up or radiate maximum energy from given directions. Fig. 5 shows the orientation curves of the three types mentioned. The curve at A is for that of a vertical wire or umbrella aerial where it will be seen that radiation or reception will have an equal strength from all directions and this type, therefore, might be said to be suited for "all around" work. It is, however, not always convenient nor practical to obtain the great height of wire spread in order to secure the necessary wavelengths. That is why the flat top is mostly used. The curve at B is for that of a flap top, T aerial in which case greater orientation lies in two general directions. This type is a frequent one in use by amateurs for transmission, as it is well suited for the short wave work of 200 meters. The lead-in in this case should be connected exactly in the center because if connected slightly to one side, theoretically there will be a slight loss of received or transmitted energy due to unbalanced current-paths for the high frequency oscillations. This may be understood by referring to Fig. 6.

The curve at C is for that of an inverted L aerial and, as may be seen, is not unlike the shape of a shoe. Maximum orientation occurs in the direction pointing from or to the lead-in end and exactly *opposite* the free end. Therefore, if you wish to somewhat *direct* your transmission or reception in a certain line, the lead-in end should point that way. In other words, flat top aerials of the T and L variety have directional qualities. By studying B and C it will thus be seen that the directional maximum lies in the *plane* of the aerial while the point of minima lies at right angles to the plane. This point should, therefore, be remembered if directive results is your aim.

The height of an antenna also decides to a certain extent its wave length. In other words, as you increase its height you accordingly increase its natural or fundamental wave length. *In general, the greater the height the better distance results are secured.*

If you live in the country near a mountainous section consult Fig. 7 and try to avoid installing your antenna in what might be called the "dead zone." In wave propagation the transmitted energy is said to travel over the earth's surface in a straight line, except that upon reaching obstructions such as mountains, hills, etc., the waves are deflected in such a way that a considerable space on the other side of the hill is *overlapt* before the waves finally reach their normal level. For that reason, if your station happens to be in the hollow or at the base of a hill, very poor receiving and transmission will result. This is not a theory but has been proved quite frequently in the case of regular commercial installations where the "dead zone" effect had been overlooked. A broad rule is to *erect the aerial at such a point that its distance from the mountain or hill will be at least four times the height of the obstruction.*

INSULATION OF AERIALS.

An aerial installed solely for the purpose of reception need not be as carefully insulated as that installed for the purpose of both transmission and reception. This, of course, is due to the fact that the intercepted energy in a received aerial is very small and does not need much insulation as compared to the high potential stress which takes place in an aerial used for transmission, particularly spark coil transmission where the voltage is sometimes very high. A good rule to follow, however, is to assume that the aerial will *eventually* be used for transmission and therefore should be insulated for such work at the very start, making use of good quality insulators.

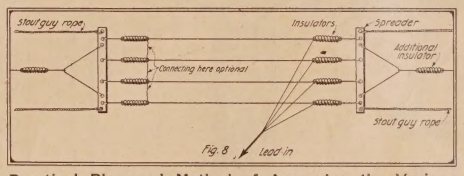


Fig. 8

Practical Plan and Method of Arranging the Various Parts Necessary to the Construction of Efficient Aerial, in This Case the L Type

Insulators should be placed in the positions shown in Fig. 8. These insulators may consist of the regular manufactured kind, but if the beginner is pressed for time or is short of money, ordinary electric light wire porcelain cleats which are about four inches long and have holes at each end, may be used instead. As for the lead-in insulator, this may also be one of the regular kinds sold by any radio supply house, but if not procurable porcelain electric light wire floor tubing may be used. Great care must be taken in bringing the lead-in thru a house to the instruments in such manner that it be quite clear from all obstructions, such as tree branches, metal roof, cornices, water-pipes, etc.

KIND OF WIRE TO USE.

Phosphor bronze aerial wire is admittedly the best kind to use in any aerial, in fact, it is used exclusively by Government and commercial stations on account of its great tensile strength combined with its good conductivity. It is usually stranded and comes in several sizes such as the seven strands of No. 19 wire and seven strands of No. 21. (B. and S. gauge.) The experimenter may use No. 14, B. and S. hard drawn copper wire. Aluminum wire of the same size is also successfully used on account of its lightness in weight and low price. There should be as few joints as possible in aerial wires. Where they are necessary, however, the connection should be made as shown in Fig. 8 and then soldered to insure a perfect contact free from possible future corrosion.

An antenna suitable for receiving work may consist of two wires spaced about ten feet apart and possibly two hundred feet or more in length. For the amateur *who wishes to transmit,* however, it is advisable to use from four to eight wires, but since an amateur must not exceed two hundred meters in wave length, *the linear length of such an aerial must not greatly exceed one hundred feet in length for the inverted L type, and one hundred and thirty-five feet for the T type;* nor should the effective height of such antennae greatly exceed thirty-five feet above the earth, otherwise the fundamental or natural wave length will increase accordingly.

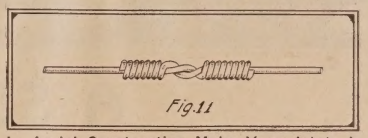


Fig. 11

In Aerial Construction Make Your Joints in This Manner, then Solder Them for Permanent and Fool-proof Joint

A FEW INSTRUCTIONS IN ERECTING.

In laying out a permanent antenna try to avoid spanning it parallel to nearby high or low voltage power lines or telephone and telegraph wires, particularly if you intend to transmit. Otherwise you will be bothered by undesirable induction while receiving, or you may set up dangerous high frequency potentials in these adjacent wires when you use your transmitter. For this reason it is a good rule to erect an antenna at right angles to such circuits when they are close to your station.

In the erection of aerials in rural or suburban districts spanning is seldom a difficult matter. In large cities, however, it is another proposition, for then there are streets, car and elevated lines, lofty buildings and what not, which must be considered. This is particularly the case when the amateur desires to erect a long aerial suitable for long wave reception, for it is then that he finds that the average city building roof has its limitations. If a stretch has been decided upon which involves crossing streets or lofty heights and providing permission has been secured from the owner of the distant building to which the free end of the aerial is to be attached, the writer has often used the following unique method of spanning.

A favorable opportunity is awaited until such a time as a fair wind is blowing toward the general direction of the distant building. An ordinary kite is then raised to which has been attached a good grade of string or cord. When the kite is di-

(*Continued on page* 38)

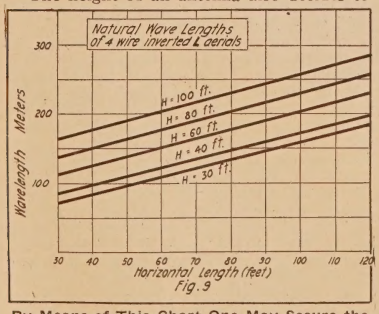


Fig. 9

By Means of This Chart One May Secure the Approximate Wavelength of an Inside Wire L Antenna by Means of Its Length and Height

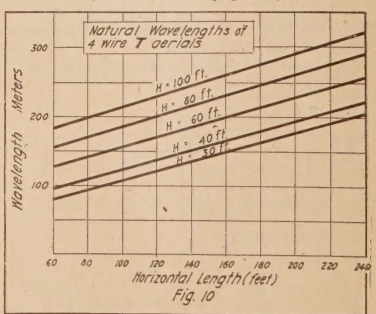
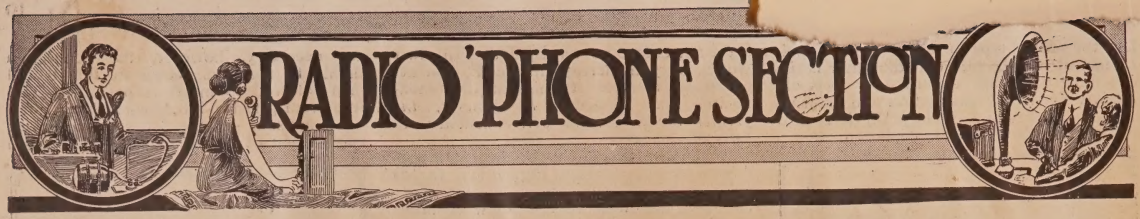


Fig. 10

This Chart Will Give the Approximate Wavelength of a Four-Wire T Aerial by Means of Its General Dimensions



A Simple Radiophone

By FREDERICK J. RUMFORD, E.E.*

AMATEURS and professionals should thoroly understand that the difficulties encountered in the transmitting of speech without wires is considerably greater than the transmission of signals by means of radio telegraphy.

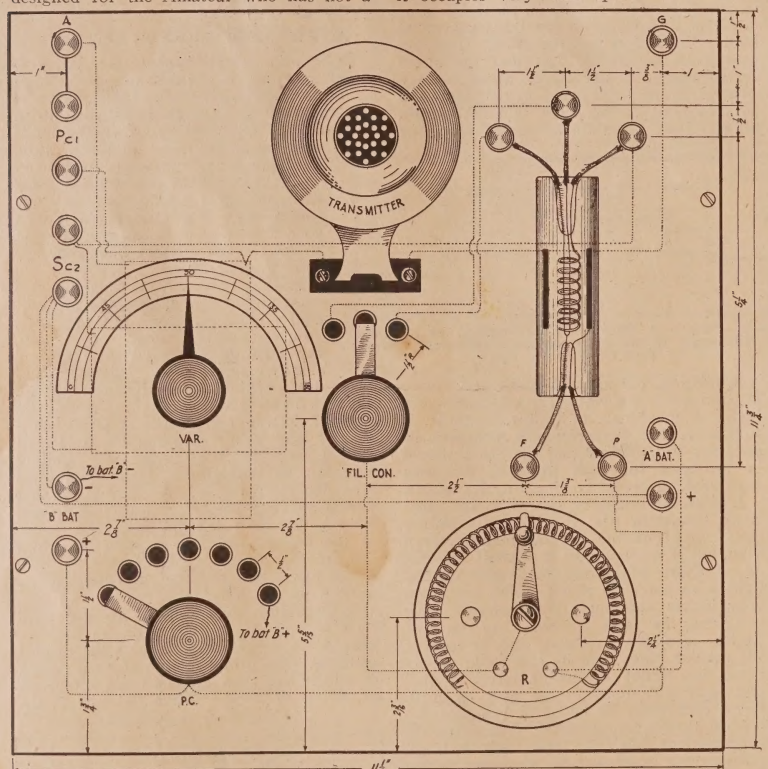
This outfit that I now bring to your attention has been tried out practically and has proven very efficient for the transmission of speech over short distances. It was designed for the Amateur who has not a very fat purse, in fact can easily be made up at the cost of a very few dollars; that is, providing the said Amateur has on hand an Audio-tron or a Marconi Vacuum Tube and also a set of B-batteries. The writer has experimented with the Marconi V.T. tube but has obtained better results with the Audio-tron.

The writer has conversed with friends at a distance of several miles and the outfit proved very effective. At the present writing a number of very progressive radio men are building outfits similar to the one described in this article. The builder of this set is one of the old timers in the radio game who has good working knowledge and practical experience in all lines of radio work. To this end, the writer has a laboratory fully equipt for the carrying out of radio and electrical experiments of all kinds and of all natures.

This radiophone outfit is simple for two reasons; first, it is easily made up, second, it occupies very little space. It is inexpensive, being within the purchasing power of the average Amateur. It is also quickly assembled, being of fewer parts than the average radiophone outfits.

The blueprint accompanying this article is as follows:

Figure 1 represents general layout of the front view of the panel, showing wiring which is on the back of panel, shown by the thick heavy lines; dimensions shown by dot and dash lines, also, correct positions of the various articles and apparatus.



This Assembly Shows Construction Details of the Set with Necessary Explanation of Hook-up, etc., Mentioned in Text by Mr. Rumford.

In Figure 1 on the negative (—) side of the B-battery, is shown a wire to battery B —, which means that that wire runs directly back of panel to the negative (—) side of the B-battery, which are mounted in back of panel. P.C. represents plate control; var, represents variometer; A, aerial; G, ground; R, rheostat; g, grid; f, filament; p, plate; P C1, primary condenser No. 1; S C2, secondary condenser No. 2; and fil-con, represents filament control for the purpose of using either filament at will.

Figure 2 shows a general wiring diagram of the whole outfit connected up ready for use, including external hook-ups.

The best way of placing the "B" batteries is to arrange them at the back of panel directly below the transmitter arm and between the two side brackets which hold the panel upright.

Now we will pass on to the making up of this outfit starting with the panel and continuing on until the outfit is ready for use.

The panel may be of Bakelite, rubber or oak. In this particular instance the writer has used oak on the outfit described as it is cheaper and easily within the purchasing power of the average Amateur, not costing more than 75 cents or a dollar at the most. The dimensions of said panel are respectively 11¾ inches high, 11¼ inches wide, and ⅜ of an inch thick. It is advisable to measure off and drill all holes that are necessary; then, the panel is ready for painting and varnishing, whichever the Amateur prefers to do. That is left to his own judgment. The writer used a dull black paint on the outfit described.

Now that the panel is dry, the next step will be to mount the different apparatus. (The making of the primary and secondary of the variometer will be fully explained a little further on in this article.) It is advisable to mount the panel on bracket forms previously mentioned as by doing so it will leave the wiring easier for various changes of the hook-up. It is also best to use ridge wiring thruout the whole panel. The panel should be screwed firmly to the bracket, it is advisable for the Amateur to make the bracket up to the best of his own judgment.

The primary form of the variometer is of heavy cardboard or Bakelite, and its dimensions are respectively 2 inches long, 4⅛ inches in diameter, and with walls 1/16 of an inch thick. It is advisable to paint the form with a good coat of shellac and let it stand to dry thoroly before winding the wire on it. After the form has dried, drill an eighth inch hole thru the center, allowing the placing of a one-eighth inch shaft for the purpose of rotating the secondary coil within the primary coil. There is also a small hole drilled at each end of the coil to permit two small screws with nuts to be fastened on. To these screws will be connected the start and the finish of the coil windings. Con-

*Manager Rumford Radio & Electrical Engineering Laboratories.

nected from these screws will run a flexible wire to the binding posts on the panel, thereby eliminating the possible chance of the wires getting broken off short. These flexible wires may be made of No. 18 lamp cord.

Now we are ready to pass on to the winding of the primary coil. It will be wound with No. 26 S.S.C. magnet wire and the winding will start one eighth inch in and continue to one eighth inch from the end. There will be 91 turns of wire in all, making a total of 98 feet 8 inches of wire but it is best to obtain about 120 feet of wire which will leave a sufficient amount for the starting and finishing ends. It is also advisable to purchase one-eighth pound of wire in case the Amateur would like to make up several of these coils. After the wire is all wound on the form, it should be given a coat of shellac. (I wish to state now that when you apply the shellac to the coil, use a very thin coat of it, and it is then advisable to let them dry over the stove for a couple of hours, the reason for this being that shellac forms an imperfect dielectric, thereby causing energy losses.) Just before the wire gets firm and solid on the form take your screw-driver and wedge apart the wires over the hole so as to allow the secondary rotating shaft to be pushed thru, allowing plenty of freedom for the shaft to work. Now that the coil is ready to mount on the panel, it is best to mount it with two small brass wood screws. There is an eighth inch space at each end, which will give plenty of room for the two screws. These screws should be about one-half inch long, that length being ample enough to hold the coil very nicely.

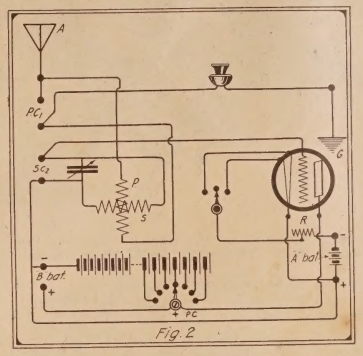
Now for the make-up of the secondary coil which is similar to the primary coil. The secondary form of the variometer dimensions are respectively 2 inches long, 3¼ inches in diameter and with walls of 1/16 inch thickness. It should be shellacked, drilled etc., just as was done before on the primary coil form. After this coil is dry it is ready for the winding, and, it should be wound with No. 30 S.S.C. magnet wire. The winding will start one eighth inch in and continue to one eighth inch from the end. There will be 134 turns of wire in all making a total of 109 feet 7 inches of wire but it is best to obtain about 125 feet of wire which will leave a sufficient amount of wire for the starting and finishing ends. It is also advisable to purchase one eighth of a pound of wire in case the Amateur would like to make up several of these coils. After the wire is all wound on the form, it should be given a coat of shellac. Just before the wire gets firm and solid on the form, take your screw-driver and wedge apart the wires over the hole so as to allow the shaft to be pusht in tight. This secondary shaft should be about five and one half inches long and one eighth inch in diameter. On the front end of it should be soldered a one and one quarter inch knob and pointer. In front of this pointer have a 180 degree celluloid or brass scale. In back of the panel this shaft is threaded its entire length. It will have nuts drawn up close to the secondary form at the back and front at each end on the secondary form as this will serve to hold the secondary coil very firm and tight, thereby allowing it to revolve very easily within the primary form. At the front of the panel the pointer will indicate on the scale the degrees revolved,

The contacts used for the filament control, and the B battery plate control switches are 1 inch long with a head 3/16 inch long and ¼ inch diameter, of either copper or brass. The switch knob is one and three eighths inches in diameter and swings in a radius of one and one-half inches. This three contact switch is for the purpose of using either filament of the Audio-tron at the will of the Amateur, and the seven contact switch is for the purpose of regulating the positive flow of the B battery to the plate. Six of these contacts are connected with six different taps on the B battery in the back of the panel, the seventh contact is an idler.

The transmitter used with this outfit is of the type which the Electro Importing Co., has for sale at the small cost of one dollar, and it has proven very efficient and suitable for the needs of the outfit in question.

The binding posts can be either copper or brass whichever the Amateur prefers; it is advisable to have a screw about 2 inches long and 3/16 of an inch in diameter; use plain brass washers, there are 15 binding posts in all.

The purpose of the two binding posts at the B battery is meant for the times when the Amateur would like to test out his B battery, but the average B batteries are usually made up so that it is impossible to test them unless you disconnect them. The primary coil has two binding posts so that if the Amateur would like to shunt a condenser across the posts, it could easily be done. It is best to use one with .005 mfd.



General Wiring Diagram of the Whole System Connected Ready for Use. In This Hookup Various Instruments Are in Proper Position.

capacitance. If a condenser is used, the secondary has two binding posts in order to shunt a condenser with a capacitance of 0.001 mfd. This condenser is essential as otherwise your outfit would not prove a success, but it is best for the Amateur to use his own judgment as to what condensers to use.

Figure 2 gives a good description of the general hook-up and connections of this outfit.

The writer has used a rheostat with a resistance of from 10 to 15 ohms, and in fact the ordinary battery rheostat will do very nicely. The filament is lighted with a 6 volt 60 ampere hour storage battery.

The writer used from 10 to 15 No. 703 Eveready flashlights batteries wired in series. There are six taps taken from the last six batteries these taps running to switch contacts on the front of the panel, thereby regulating the B battery current. In Figure 3 is shown the method of mounting the B batteries at the back of the panel between the two bracket braces as well as the method of mounting the telephone transmitter. As will be seen in Figure 2 the wiring is very simple and there are not many wires to contend with. I think if the blueprints and the descriptions are worked out carefully that the Amateur will be more than pleased with the results obtained.

The blueprint is self-explanatory and if followed closely will enable the Amateur to build up this outfit correctly.

OPERATING DATA.

The writer has tried different experiments in connection with this outfit such as the following, conecting this circuit with a loop which brought very good results, connecting a receiving loading coil in series with the primary and the aerial. This connection will increase the transmitting power of the outfit greatly. In the course of his experiments the Amateur will come across a number of good circuits which will prove of great value to this outfit. While on the subject of experimentation, the writer might add that even while the set is instructive, it is also a great source of pleasure, as the Amateur and his friends, can converse with other acquaintances. In fact, why wouldn't it be a good idea for a group of boys, or rather young men, to form a club for this purpose? We might also recommend that when a young man is making the outfit up for his own use, he might take advantage of the opportunity and make up two outfits. He will easily be able to sell the second outfit for at least what his own cost him.

Editor's Note: *In a recent letter received from Mr. Rumford he mentions the fact that he has actually covered a talking distance of 5 to 7 miles when employing from 180 to 200 volts on the plate. However, it is not every Amateur who has this voltage "on tap" so that with the lower plate potential of 50 volts more modest results are to be expected; the author having covered between 3 and 4 miles effectively. All other things being equal, it is thus evident that a higher plate voltage will produce correspondingly better distance results.*

RULE FOR WAVELENGTH.

A good rule for estimating the wavelength of the antenna is as follows:

Add the length to the lead-in. Add to this the ground and if there is more than one wire, one-third of the length of the aerial. This is in feet. Divide this total by 2 and add the result to the addition above made. This will give the approximate wavelength in meters. Example: Length of aerial, 65 feet; lead-in, 12 feet; ground, 20 feet. 65 plus 12 plus 20 eq. 97. Add 22 eq. 119. Divide by 2 eq. 59. Add 119 to 59 eq. 178 eq. wavelength. Here the fixt factor is to add to the length of the aerial, the ground and the lead-in, *one-third of the length of the aerial.*

This will help the amateur to determine the natural wavelength of his aerial. If he will not have this longer than about 160 meters, he will not exceed his allotted 200 meters after he has added the additional length to his antenna circuit by the secondary of his transformer and the condenser.

May I suggest to readers the study of the use of the tin roof of the house over which the aerial is strung as a ground, using no other ground than this? Connect the roof by soldered No. 4 wire to both front and back. Here the roof acts as the lower plate of the condenser aerial, the latter being sufficiently above it to be effective. Mr. Ferris, of Philadelphia, has for some time used the roof solely as his ground, getting more amperes into the circuit than when he used the water pipe or gas pipe system. The flat-top aerial might well be parallel with the roof and not slanting as is common. Mr. Roberts of this city unites two roofs in one and gets more radiation than with one.

When the roof is used as a ground, the estimate of the lead-in is from the aerial to the set and of the ground from the set to the roof and not to the actual ground.

It will be interesting for the amateur to try this and report results.

Contributed by

GORDON M. CHRISTINE, M.D. (3BF),
President of Philadelphia Amateur Radio Association.

"The President's Special"

By THOMAS W. BENSON and CHARLES S. WOLFE

THE Storm King held full sway. With terrible persistence the wind-whipt snow whirled down on city and hamlet, on street and field. The white blanket rapidly grew into a knee-deep quicksand. And then the bitter wind took up its blizzard task, drifting, drifting, drifting. An ice-cut, bare-swept corner, here, a soft, relentless mountain there.

Within the station a little group awaited the express. There was an overworked business man there in the corner, pacing to and fro with nervous step, his mind doubtless crammed full of calling responsibilities, only vaguely aware of the White Terror without, inwardly fuming at his enforced wait. Flanked by two black bags, a young and very pretty woman sat as close to the radiator as she possibly could, very much aware of her comeliness, and scarcely concealing her interest in the well-groomed traveling salesman who was hurrying thru his order-book so that he might begin a very promising flirtation. A pair of chattering Italian laborers, off to new fields of endeavor, carried on a gesticulating conversation over by the telephone booth, while the quietly dressed detective wondered what would happen if some one were to tie the hands of these swarthy fellows. When not engaged with these rather fruitless speculations, he bethought him of his journey westward, undertaken to bring back to justice a yegg captured yesterday in a far-off city.

"He Turned Savagely to the Corner Where the Little-Used Radio Telegraph Outfit Was Housed"

And while these folks waited in comfort, down in the yards below them a train crew risked life and limb momentarily in an effort to make up the train that was to carry the waiting group to their various destinations. And up in the tower the dispatcher and his little band made Herculean efforts to safeguard them while they rode, a task that resolved itself into a struggle between falling snow and falling wires.

For dying sounders gave evidence of breaking circuits, and junction after junction, station after station, lapsed into silence, and the staccato bedlam of a few hours before became a fitful chattering. The slender, miles long copper nerves which they had so cunningly strung out from this gigantic brain were failing, snapping under their burden of snow, yielding to the terrific strain imposed by the slashing wind.

The dispatcher tried in vain to get in touch with the other terminal of the line. Five minutes of patient calling brought forth no response. Cursing under his breath, he turned savagely to the corner where the little-used radio telegraph outfit was housed. Rigged out as an experiment, it had never outgrown that stage. Now it occurred to the overwrought dispatcher that in this extremity the equally overwrought chap at the other end might be turning to this storm-proof hurler of intelligence as a possible means of reaching him.

Donning the receivers, he twirled the controlling knobs of the coupler, hovering around the wave length where Mountain City would come in if he was on the air. Not a chirp rewarded him. To make sure that the set was working he dropped down to two hundred meters and was greeted by the hoarse roar of some amateur's spark as that worthy chatted amiably with a kindred soul some place on the globe. The dispatcher did not linger to read any of the banter. He snapped the antennae switch over viciously, his long, nervous fingers closed over the key and the blue flame leaped in the whirling gap as he pounded out the call.

As the man-made lightning died down to stunning silence, and the switch blades hooked in the receiving instruments, there came to his straining ears the high-pitched answer from the station at Mountain City.

Sighing his relief, he shot back the stream of questions, answers to which he must have before he dared start that little group of passengers waiting down there in the station, whirling out into the storm-torn night. What trains were moving? Where were they? Could they be reached from the Mountain City end?

As the answers to his queries whispered into his ears from out the snow-laden air his face cleared. Swiftly he formulated his plan of action and then sent it leaping thru the ether to the alert man at the other end.

"Get everything off the metals as soon as possible. Side track what few trains are moving wherever they can be reached. Give the express a clear right of way from one end of the line to the other, and let her try to make it."

As Mountain City acknowledged, he swiftly reviewed the location of the few experimental radio stations strung along the line. Thank fortune, he reflected, there was still one this side of the nearest eastward moving train, at which point it could be held. That would give the express undisputed right of way to the other terminus.

The heretofore little considered radio system went up several notches in his esteem as he rapidly wrote out his orders. To the conductor of the express, along with his usual papers, went the order to add the experimental coach which contained the traveling radio station to his train. It was lying unused on a siding in the yard. An overworked operator hastily donned his overcoat and stumbled thru the blinding smother down to the car, and while the coach was being added to the train worked feverishly to get the set into operating condition, if such a thing was possible.

On scheduled time, grisled Tom Murphy brought his train to a grinding stop at the station platform, and with a sigh of relief the tired business man scrambled aboard. The two Italians laborers and the detective made their way to the smoker, while the pretty young woman, chatting comfortably with the traveling salesman, settled herself and her bags in a Pullman chair. Seated in the warm cars, they all forgot their tiresome wait at the station and settled themselves down for their long ride thorugh the night.

As the signal over his head hissed twice, Murphy lifted the latch and the express moved out into the storm. Clearing the yard limits with a warning whistle shriek, she gathered momentum and her red markers merged into the storm blackness.

Back in his coach the operator reached out thru the darkness for the office he had just left. The whirling gap above his head flamed and died as he sought to establish contact with his chief.

The answering roar of Danville's spark greeted him as the antennae switch went up, and the five K.W. poured his chief's instructions into his ears. Maintain constant watch thruout the ride. Inform the home station at once as unusual conditions arose. Orders would reach him as developments transpired.

After he had acknowledged, he heard Danville calling Mountain City. Tuning swiftly, he was able to catch the other's reply, and as he read off the message from the other end of the line he realized that no orders would be necessary from the data just sent. Danville was reporting a practically clear track, for most of the trains had been successfully reached and orders for the two that were still moving were already awaiting them at stations beyond their last reported points.

As Danville's O. K. died away the operator on the train heard a faint, whistling signal, and as he brought the station to tune read one of the other company stations reporting to Mountain City the successful side tracking of one of the remaining trains there.

Interested in this very practical demonstration of the utility of the radio, he fell to wondering just what he could get out of the set, and opened up with a call for the station which he had heard talking to Mountain City. To his amazement, his call was answerved at once and he chatted a while with the man at that junction.

Calling his chief at Danville when he had finished, he reported establishing communication with Bear Creek. The dispatcher, relaxed now and enjoying the rather novel sensation of chatting with the speeding express, replied that he had read the conversation and instructed his operator to see what he could raise.

Nothing loathe, that worthy began calling several stations, with varying success, and as grim Tom Murphy on the lurching monster ahead fought out his battle with the rampant elements and snow-filled cuts, he kept in constant touch with his chief and others.

And so, while the passengers slept or chatted in the coaches behind, the flaming sparks crashed, and the slender finger of the wireless hovered over them protectingly thru the night.

And along the right of way, in a lonely, storm-battered farm-house, a young fellow sat late into the night at his little table, the 'phones over his ears unfolding to him the marvelous happenings of the night. He had picked up Mountain City's first futile calls for Danville and, fully awake to their import, he had followed breathlessly the progress of events as the finger of fate wrote possessed him.

He had sighed in relief when Danville came on the air, and the scrawled pad before him contained every word of the conversations since. He had succeeded in tuning in all the railroad stations, and his delight was boundless when he had raised those first calls from the station on the speeding train.

He thrilled and marveled as he copied the rhythmic Continental from the rail, and again and again his fingers crept to his key as the desire to raise that speeding station possest him.

But with that good sense which is the joy of every one who knows the average amateur, he hesitated to butt into the exciting game. He feared that his spark might be engrossing that all-important operator just at the critical moment when Danville or Mountain City would want that train station vitally.

And then the moving finger of destiny began writing in good earnest. For from Danville came a coded message for the road's president in Mountain City. The youth at the table copied that coded message, but attached no importance to it, and for thirty minutes more listened to the chatter between the stations along the road.

But in Mountain City that thirty minutes was eventful. A call-boy had gone forth into the night to arouse the sleeping official and deliver that coded message. Duly delivered, it had brought action with a vengeance. For in a marvelously short space of time the president's limousine had whirled up to the railroad offices and the president burst in on the dispatcher, bellowing for his special train. He must go to Danville, and he must go right away.

Orders flew thick and fast, and before many minutes had elapsed the panting monster had drawn up to the station platform and the special had lunged eastward into the night.

The dispatcher turned to his set. He raised Danville, and the flickering spark told of the departure of the president's train.

At his instruments, the youth copied this message with interest, and then realized what a part the wireless was to play. It now became its mission to halt the rushing express at some siding along the way in order that the special might go by safely.

He heard Danville and Mountain City agree on the point of passing, and chuckled with amusement and amazement as he realized the error they had both made. For even as he heard Danville get Eagle Pass and hand him the order to set the board against the express he realized that that juggernaut had left the Pass behind her ten minutes before.

Eagle Pass quickly informed the dispatcher at Danville that the express had passed his station. There was a silence as the dispatcher digested this fact. Then he called Mountain City for a hasty conference. Quickly they agreed on the next passing point, and then into the lad's ears came the startling intelligence from Mountain City: "There is no station equipped with radio between the Pass and the two trains."

Then, with relief, the boy though of that station on the train, and nodded with satisfaction as he heard Danville report that he would give the order direct to the train.

A moment later the call for the express was thundering through the ether.

Silence.

Again the whistling dots and dashes. Again silence.

Again, and yet again, the big station reached out after the flying express, only to receive no reply. The train which had been chattering away a half hour before was "off the air."

"And in a Little Farm House a Youth Thanked God That His Little ½ k.w. Had Broken Thru"

A little concerned, the youth made a rapid calculation. Then he whistled softly. For reckoning from the last report from the express, and estimating the speed of the special, he reached the conclusion that the two trains were only a few miles apart, and each doing its best to annihilate the remaining space in the shortest possible time.

Breathless, he listened. Danville gave over calling the train, and raised Mountain City. "I can't get the express," the whistling Continental said. "See if you can reach the special."

Came the terse reply: "Special not equipt. Better get the express."

Danville wasted no time replying. Again and again the call for the train shrieked thru the night. But not a signal came back in answer.

Once more the whistling signals spelled out the Mountain City call, and the roar of that station sounded in answer. "You try for the express," said Danville, "I can't reach him."

In obedience the Mountain City operator stung the ether with calls for the express. Over and over again came the now-frantic shriek for the train. But no answering signal came from that station.

With dismay the youth at his table guessed the truth. By a trick of fate the deadly freak had intervened. *The express was in a "pocket."*

On the train the tired business man, his turmoiled brain at rest, slept peacefully. The two Italian laborers, unconscious of onrushing disaster, snored in their seat in the day-coach. The girl and the salesman, defying the summons of outraged bodies, chatted on between yawns. The detective dreamed peacefully of home and his children.

Out on the engine Murphy strained his eyes as he tried to penetrate the whirling snow. He cursed as he realized that he could not see the block signals at all. But still, like a good soldier, he drove her on into the night.

And back in his coach, the operator puzzled over the absolutely silent atmosphere. Not that he worried, for he was assured of the right of way. But he realized that some conversation must be passing between the road stations, and he was hearing nothing. He jotted this fact down on his report sheet.

Totally unaware of the menace hovering over his train, he leaned back yawning to light a cigarette.

And while he smoked contentedly away, Danville and Mountain City shrieked his call letters in a frenzied duet. Both dispatchers had lost their heads and had he been able to hear their calls he would hardly have been able to straighten out the tangle. They were jamming each other hopelessly.

And with this bedlam ringing in his ears, the amateur in his lonely farm-house reached a decision. Gritting his teeth unconsciously in the emergency, he reached up to his oscillation transformer and deliberately threw his set out of tune. Hastily he prepared to throw the broadest wave he could possibly emit. He glanced at the last useless train order copied on the pad before him.

And then the whirling gap above his head spit fire as the little half K. W. transformer staggered under the overload.

With condensers perilously near the rupture point, the wailing gap blazed out its supreme effort to penetrate the fatal pocket and save the tearing trains from disaster.

"H. Q. H. Q. H. Q.," it seemed to the boy that his condensers simply must go. "Msg. Msg. Msg."

Daring to plug her no longer, he threw his switch over to receive, and strained his ears for a token that his wave had broken the barrier.

The wailing shriek of Danville blended in fearful, unharmonic duet with Mountain City's roar smote his tensed ear drums. He realized that if the express was answering it would be impossible for him to get the weak signals.

He resolved to risk everything on one mighty slender chance. Down went the antennae switch, and again the blue lightning flashed, and broadcast went the warning to the Death-headed express.

"H. Q. H. Q. H. Q. Msg. here for you to side track. President's special running against you. Too late. Back her."

Again, and yet again, he flung his warning into the snow-filled ether. And then the outraged condensers gave up the struggle against overwhelming odds. With a straggling red sputter, the whirling gap lapsed into silence.

With a sob the boy relaxed his hold on the key and jerked the antennae switch up. The air was still hideous with the bedlam from Mountain City and Danville, aided now by a howling wail from Eagle Pass.

But to return to the express.

An icy blast from the opened door heralded the entrance of the conductor and the smoking operator waved his hand in greeting. "Howdy, Powers," he said. "How's tricks?"

"Pretty fair," replied the conductor. "How under Heaven does Murphy keep her rolling through this snow? According to Hoyle, we should have stalled hours ago."

"Great little boy, that," nodded the oper-

(*Continued on page* 40)

RADIO DIGEST

AN AUTOMATIC CALL DEVICE.

By B. Binyon, B.A., O.B.E.

The short space at our disposal does not permit treating this subject historically, but as a matter of interest it is worth while noting that the early forms of radio apparaus, operated by a coherer with relay and bell, constituted an elementary form of call apparatus and doubtless the advantages of being able to ring up in the manner of line telegraphy and telephony was considered of great importance at the time. It is probable, however, that the introduction of aural reception presented so great an improvement in reliability and sensitivity over the old coherer methods as to completely swamp any benefit to be gained by the use of "call-up" apparatus; moreover, aural reception has come to be so universally applied to radio communication that it is now difficult to conceive of any mechanical substitute having the sensitivity and discriminating qualities possest by the human ear.

The development of mechanical appliances to minimize skilled labor must now be regarded as the progressive aim of every branch of modern engineering. The difficulties encountered in the design of such appliances usually increase in proportion to the delicacy of the operations to be performed, more particularly so where mechanical devices have to attain a sensitivity and selectivity equivalent to that of the human senses.

The mechanical "call" or watchkeeping apparatus may be attached to any Radio receiver in lieu of, or in addition to, the head telephones usually worn by the operator.

The apparatus consists of two units:

(1) A sensitive relay operated by thermiomic valves (vacuum tubes).

(2) The mechanical selector.

Demonstrations were given by means of a buzzer in which the apparatus rang the bell in response to the distress signal SOS and the call letters 2AA and *disregarded all other signals.*

At the conclusion of the discussion signals were received from Slough ringing the bell in response to the call letters 2AA. The apparatus was also shown actuating on signals from North Foreland Wireless Station and the Air Ministry—*Abstract of a lecture read before the Wireless Society of London,* April 20, 1920.

RADIO COMMUNICATION ON FRENCH RAILWAY TRAINS.

The French railway administration has recently preoccupied itself with radio experiments whereby it has attempted to establish satisfactory communication between the engineer of one train with that of another train several miles behind or ahead of it.

Of course there is nothing new in the application of radio to railroads, some very interesting experiments having been conducted by the Delaware, Lackawanna and Western Railroad several years ago. The experiments demonstrated notably that the instruments must bear special connection and arrangement and that a special wavelength may be used, owing to the fact that with this system the present antenna does not absorb sufficient energy. It is also necessary to devise an artificial ground or counterpoise rather than seek to establish an actual ground thru the wheels and relay of the car.

By the end of 1914 the French radio telegraph service operated with entire satisfaction to everyone; that is, the public as well as the equipment personnel. In consequence it was thought that since the telephone had replaced the telegraph in railroad work, radio telephony would probably prove equally adaptable in place of radio telegraphy.

Thanks to Mr. Lee DeForest in connection with the work of one of his engineers, Mr. C. Logwood, two special types of radio sets were constructed for these tests. This system consisted principally of microfone transmitters, tungsten filament vacuum tubes, simple amplifier and an alternator of 40,000 cycles propelled by a Sperry steam turbine which had a capacity of 4,000 revolutions per minute. The power unit was placed in the baggage car and the turbine motor supplied with steam directly from the locomotive.

With this equipment reliable communication was establisht up to 180 kilometers. —*L'Electricite Pour Tous.,* April, 1920.

AERIALS—THEIR FORMS AND USES

By Philip R. Coursey, B.Sc., A.M., I.E.E.

An interesting and highly instructive article appeared in the *Wireless World* (England), of May 15, 1920, under the above title. The writer begins with the early form of Marconi aerial and gradually explains the various types such as the Lodge aerial with no earth connection, the Maltese Cross aerial, the fan shape aerial used at Poldhu as well as the typical forms of modern aerials, which includes the umbrella T and the inverted L. Attention is given to the closed loop type of aerial referred to as frame aerials, of which the writer has the following to say:

"These loop aerials have, in addition, valuable directive properties; that is to say, they are capable of transmitting or receiving best from one or two directions as compared with the more uniform distribution of radiation resulting from the ordinary open aerials. The various other forms of directive aerials used with different sets of apparatus and for various purposes are mostly modifications of the simple loop."

Radio Articles in July Issue Electrical Experimenter

Radio Controls Naval Ship Target at Sea

Listening for Signals from Mars—By Dr. Frederick H. Millener

A War-Time Radio Detective, Part 3,—by Pierre H. Boucheron

Free Radio Course for Ex-Soldiers., a Story of the "K. of C." Post War Services, — by Wm. M. Bolger

Marconi—The Master Radio Experimenter, with Photo of the Signor

Spark Gaps for Radio Amateurs and How to Build Them,—by Pierre H. Boucheron

Have you a Wireless "Scrap Book"? —by Albert Lee Woody

Antenna Radiation and Ground Resistance,—by E. T. Jones

Transformer Using Spark Coil Parts

A New Telegraph Code

Wireless and Electrical Laboratory Monthly Prize Contest

THE AMATEUR IN FRANCE.

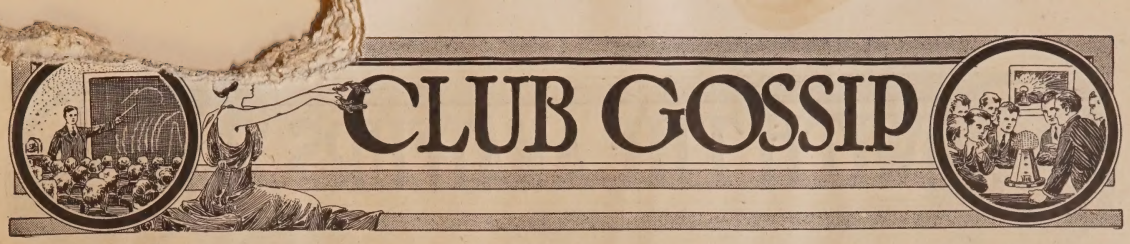
L'Electricien in its issue of March 15th last gives details of the French Ministerial decree dated February 27, 1920, embodying the rules and regulations under which small private wireless installations, for the reception of time signals and meteorological telegrams only are permitted in France. The regulations are stringent and the facilities for amateur wireless work very restricted. Transmission will not be allowed.

STRAIGHT DETECTION VS. THE OSCILLATING TUBE.

In a report of the test submitted by the Naval Aircraft Radio Laboratory a preference is expressed for straight detection and high amplification in the reception of spark signals, instead of the present system using the oscillating tube. This brings up a question that has been much discust. All of the research work done in the development of radio compass apparatus at this laboratory has indicated that reception of spark signals by means of the oscillating tube produces a much sharper minimum than that obtainable with detection and amplification. A rather lengthy and thoro investigation was carried on and a comprehensive report submitted. This report concerned itself mainly with the relative advantages of dampt or undampt wave reception in connection with radio compass operation. The data obtained in that report gives good evidence in favor of the oscillating tube method of reception. It is perhaps true that for a green operator the true tone reception may be more pleasing to the ear and for psychological reasons result in better bearings, but the generally expressed opinion of experienced radio compass operators favors the oscillating tube method. An important factor in this connection is the question of upkeep; the oscillating tube method requires but two stages of audio frequency amplification, while for straight amplification, to give the same signal strength, several stages each of radio and audio frequency amplification are required with consequently more expensive apparatus and higher upkeep.

TELEGRAPHY, TELEPHONY AND SIGNALS.

New Phenomena Discovered by Means of Vacuum Tube Amplifiers.—The tremendous energy amplifications obtainable in modern triode amplifiers seem to open up new fields for research concerning the constitution of matter. Recently Schottky stated that by employing sufficiently powerful amplifiers it should be possible to hear in a telephone the sounds caused by the individual electrons colliding with the atoms in a conductor carrying electric current. Schottky indeed suggested that a limit was set to the possible amplification obtained with electron tubes by the noises or electric disturbances emitted when the electrons impinge upon the plate of the tube. Barkhausen now has actually observed similar phenomena in ferromagnetic substances. In listening with a multi-stage amplifier across a coil wound on one leg of an iron core, he heard a crashing sound when the magnetic induction in the core was continually varied by advancing and then pulling back a magnet. He explains this sound as resulting from the electromagnetic shocks given to the amplifier when the individual molecular magnets suddenly go over from one polarity to the opposite as the field strength changes. The best results were obtained with rather thin wires.—*Physikalische Zeitschrift,* September 1, 1919.



Radio Club of America.

On Friday evening, May 28, 1920, a regular monthly meeting was held at Columbia University, Engineering Building.

After the meeting, Mr. George E. Burghard gave a dinner at his home. Among those present were Mr. E. H. Armstrong, inventor of the Armstrong circuits; Mr. E. V. Amy; Mr. George Eltz, Jr.; Mr. Harry Sadenwater, radio officer of the N. C. 1, which made the famous trans-Atlantic flight; Mr. John F. Grinan, of 2 P. M. fame, and who incidentally was the first man to send an amateur message from the Atlantic to the Pacific direct without relaying.

Mr. Burghard read a most interesting paper on a low-power radiophone which he designed and operates on 110 volts D. C.

Mr. Spangenberg explained in detail the phone he is using at his station, 2 ZM. Mr. Amy read a paper on the rectification of alternating currents for use on continuous-wave transmission, explaining the method of using transformers and comparison as to initial cost of using motor generator.

Washington (D. C.) Radio Club.

Mr. Earl C. Hanson, Expert on Audio Frequency Currents for the Navy Department, spoke before the Washington Radio Club at the June 5th meeting on the latest inventions in the Audio Frequency Electrical World and their importance and use during the World War.

Mr. Hanson described the two-plate system of audio frequency wireless communication used by our Signal Corps in the trenches by which secret communications were past rapidly along the fronts to advise, simultaneously, all troop movements. The system was brought to a practical state by his own discoveries. To the layman the idea consists in transmitting by conduction thru the earth audio frequency voice currents and picking up these currents at a distant receiving station by means of a thermionic vacuum tube amplifier connected to the two-plate system and associated with a set of head telephone receivers worn by the operator who receives the messages.

Mr. Hanson also described the audio frequency Piloting Cable system, used with such great success in guiding ships through mining fields and recently employed in harbors along the Pacific coast and in New York harbor for guiding commercial ships through heavy fogs and in darkness. The system comprises a cable which is laid along the channel bottom and supplied with a low frequency current. The lines of force emanating from the cable are picked up by an audio frequency amplifier connected to port and starboard equipment on ship, such that the energy from the cable is only received when the ship is directly over the cable. The navigator steers his ship so that maximum energy is received from the cable and thus follows the hidden electrical line of safety either through a tortuous harbor or a dangerous mining field.

Mr. Hanson also discust applications of the electrostatic phonographs in use at Walter Reed Hospital to cheer the individual bed patients who pick up music by small hand receivers from a central wireless transmitting phonograph operated by one of the head nurses in the library of the hospital.

The Washington Radio Club is rapidly increasing in membership. Meetings are held the first and third Saturdays of each month at the National Radio School, Washington, D. C. All interested in radio are invited to attend these meetings. Address any communication to the club care of the National Radio School, Washington, D. C.

The Radio Club of Burlington and Its Activities.

The Radio Club of Burlington consisting of the following members, Russell V. Swearingen, Milo A. Bloomer, Kermit R. Bloomer, Wayland Gilbert, Raymond Johnson, Raymond Sillick, Arnold Fehse, Louis Wallbridge, Byron Jeffrey and Harry H. Waugh, was organized and held its first meeting March 7, 1920.

The officers elected by the members of the club are as follows: Russel V. Swearingen, president; Milo A. Bloomer, vice-president, and Harry H. Waugh, secretary.

Our meetings, which are held at the home of Milo A. and Kermit R. Bloomer, are very interesting, and we have almost perfect attendance at each meeting.

We are associated with the American Radio Relay League as a club and in the near future practically every one will be affiliated with this organization as individuals.

On July 2d, 3d, 4th and 5th there is to be a regatta held at Burlington, Iowa, under the auspices of the Mississippi Valley Power Boat Association. This promises to be one of the largest and most successful regattas ever held in this part of the country, some of the features being fast boat races, fireworks in the evenings, high diving and performances by Mack Sennett's "Bathing Beauties" and many other events too numerous to mention.

The Radio Club of Burlington has been given the task of timing the races, which are to be held on a one-mile course between two bridges. The fact that some of the fastest racing boats in the world, such as the Miss Detroit III and others capable of making a speed of almost seventy miles an hour and also that several world's records are expected to be shattered, and also that the officials know the speed and accuracy of radio, are the reasons why the Radio Club of Burlington has been given this important task.

Leading Members of the Radio Club of Burlington, Iowa. These Young Men Are Carrying on Some Very Interesting Experiments. Read Their Club Notice and See for Yourself.

The following is a brief description of the method which we intend to employ in timing the races. We are to have a one-half K. W. transmitting station, together with a receiving set at the starting and finishing points of the one-mile course. In other words, there are to be two complete transmitting and receiving stations in all, one located at the start and the other at the finish of the course. In order to avoiod a possible mistake and to insure accuracy there are to be three official timers and two operators at each station, the operators being members of the club. When the fast boats near the starting line a dash will be transmitted from the station located at this line. The ending of this dash will be a signal that the boats have crost the starting line and exactly at the ending of this dash the three official timers at both stations will set their stop watches. When the boats cross the finishing line the order of things will be reversed.

We realize that our task is to be a tedious and painstaking one, but nevertheless we intend to put it across in the right manner and we believe that we have the honor of being the first club to try a stunt of this kind. In addition to the two timing stations we will also have, for the benefit of those of the spectators interested, for the relaying of friendly messages, for the announcement of the winners of the various races, for the sending of reports and for amateur transmission and reception in general, a powerful one K. W. transmitting station (Call 9 ACZ), together with a short-wave regenerative receiver, long-wave set and a couple steps of amplification. We also intend to have a "Loud Talker," principally for the benefit of interested spectators.

We might add here that all of the equipment to be used for transmission at all three of the stations is the property of three members of our club and has been used previously by them under government licenses. Let it also be understood that we will endeavor to comply with government requirements as much as possible, especially in regard to our wave lengths.

The time from 12:00 o'clock noon until 8:00 o'clock P. M. each day during regatta will be set aside for regatta business, such as timing the races, which are to be held from 2:30 P. M. until about 6:00 P. M. in the evening. It is also during this time that we are to send out our Q S T announcements in which we will announce at the end of each race the winner thereof. No amateur reception is to be done during this time.

Now all you amateurs get busy, put on your "cans" and when you hear us, throw your switch and let's hear from you. Remember our call (9 ACZ). Harry H. Waugh, secretary, Radio Club of Burlington, 1316 Perkins Avenue, Burlington, Iowa.

Radio Club of the Bushwick Brooklyn, N. Y., Evening Trade School.

When the United States entered the World War, there were various classes started by the Department of Education in which men of draft age could acquire skill in various branches of military service, such as airplane mechanic classes, machine shops, and radio classes.

One of these radio classes was started in the Bushwick Evening Trade School, 400 Irving Avenue, Brooklyn. The instructor for the first season was Lieut. Kranter, U.S.N. The next season the class was reopened under the supervision of Miss Sonia Soberg, with a registration of about eighteen students who wished to become efficient enough to be inducted into the Signal Corps. These young men were all rapidly advancing to a state of efficiency and awaiting their call to service when the armistice was signed.

Needless to say, this disbanded that class, but a small announcement in the Brooklyn papers the next day brought in a good-sized registration of students who wanted to take the course offered in wireless telegraphy. At that time all the equipment we had was a buzzer practice set and technical books, with no chance for practical work. However, we kept right on, and were not one bit discouraged, and before we realized it the third season had slipt upon us.

We decided to organize a radio club, and it is to the results of the club that we got the equipment we have at present. We are not working on a very elaborate scale as yet, but we are still in our infancy. We have a class-room that we can boast of as all our own. There are two tables, each about twenty feet long, wired up for code practice, sending and receiving. This work was done by the boys themselves during class hours. Next our energy was expended in rigging up a receiving station. We got together the best possible material from our small funds. At first we started with a loose coupler about 1800 meters, a crystal detector, fixed and variable condensers, which we mounted on a portable base. While we were using this, we got to work on a panel set, which was made in class. Last, but not least, we saved enough to get a one-quarter K. W. transmitting set.

All our greatest hopes are now centered in the achievements we are going to make when the new season starts in September. The club plan is going to be carried out again, but we are going to work on a larger scale.

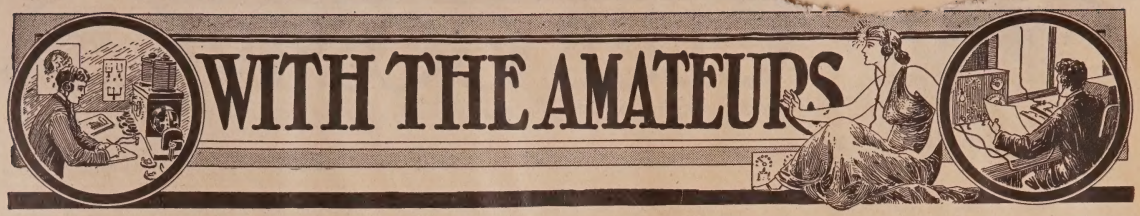
Our class accommodates about thirty pupils. Mention must be made of the fact that this is a regular evening school subject, and thoro instruction is given in code and theory. There are sessions four nights each week, Monday to Thursday, from 7:30 to 9:30 P. M.

The club leaders are those boys chosen from the members of the class. The dues are twenty-five cents per week. All radio amateurs of Brooklyn and boys with some electrical knowledge are asked to join us next September.

We should accomplish some big things, then, for we have machine and wood shops in the building and can therefore easily make some of our apparatus.

The club this term extends heartiest congratulations to the following boys on the committee: Henry Koch, George Spangenberg, Daniel Erb,

(*Continued on page* 42)



THIS Department is open to all readers. It matters not whether subscribers or not. All photos are judged for best arrangement and efficiency of the apparatus, neatness of connections and general appearance. In order to increase the interest in this department, we make it a rule not to publish photographs of stations unaccompanied by a picture of the owner.

We prefer dark photos to light ones. The prize winning pictures must be on prints not smaller than 5 x 7". We cannot reproduce pictures smaller than 3½ x 3½". All pictures must bear name and address written in ink on the back. A letter of not less than 100 words giving full description of the station, aerial equipment, etc., must accompany the pictures.

PRIZES: One first monthly prize of $5.00. All other pictures publisht will be paid for at the rate of $2.00.

"9ZN"

Rightly Called "The Hub of the Amateur Universe"

By ROBERT F. GOWAN*

RADIO STATION 9ZN holds the distinction of being the control station of the Central Division of the American Radio Relay League. The station is the property of Mr. R. H. G. Matthews, a most enthusiastic amateur, and at the same time president of the Chicago Radio Laboratory. It is located on the shores of Lake Michigan at 5525 Sheridan Road, Chicago, Ill.

The aerial system is 95 feet high over all, consisting of two steel towers each 50 feet in height supporting two 45-foot masts also of steel. The antenna is of the fan type and consists of ten wires each 150 feet in length, equally spaced and suspended on a messenger cable supported by the towers. The messenger cable is a seven-strand No. 18 phosphor bronze wire and the aerial wires are standard seven strand No. 22 tinned copper. Three 10½-inch *Electrose* insulators at each end insulate the antenna system from the steel masts.

The ground system is equally elaborate and especially efficient. It consists of the two sets of wires buried radially about the station. One set contains twenty wires 30 feet in length and No. 14 in size. The other set comprises eight wires, each 150 feet in length of seven strand No. 22 copper. There are also two wires each 100 feet in length submerged in the lake and a number of 6-foot rods are driven into the ground about the station.

A 4 K.W. special power line supplies the alternating current for the transmitting equipment which comprises a Marconi (United Wireless Telegraph Company) open core, 1 K. W. transformer. This transformer delivers a secondary voltage of 30,000 to an oil immersed plate glass condenser in series with a Chicago Radio Laboratory Hy-Rad rotary gap. The rotary gap is mounted in a padded box to make it as noiseless as possible.

On the marble panel shown in the photograph are mounted the radiation and power ammeters together with the power variation and main line switches. The transformer is located directly beneath the rotary gap with the oil condenser to the right. The condenser is of the plate glass type containing some twelve hundred square inches of active tinfoil area. It is built up in sections so that all or part of its capacity may be used with the oscillation transformer which is made of one inch brass ribbon.

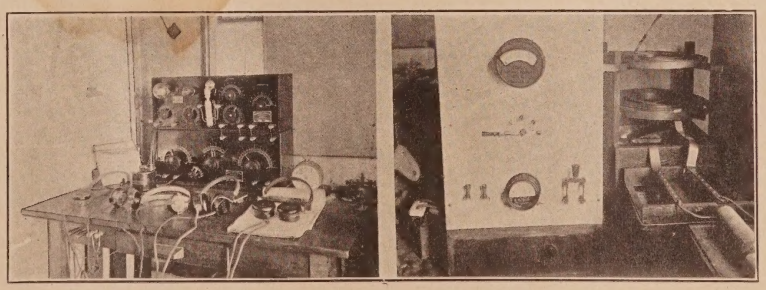
The station operates on three different wavelengths, viz.: 600, 425 and 200 meters. The aerial has a fundamental wavelength of 300 meters *necessitating, therefore, the use of series condensers for transmission* and reception of the 200 meter signals.

The equipment radiates 8¾ amperes on 200 meters and 9 amperes on 425 meters. A 3 K.W. transmitter of the same type is being installed for use on the 425 meter wave.

The receiver consists of a Paragon RA-6 short wave regenerative receiver and Amplifigon, type AGN-2, Audion Control panel and two-step amplifier. An Audiotron tube is used for detector with Western Electric VT-1's or Marconi VT's as amplifiers. Baldwin mica-diaphragm head receivers are used.

This equipment is manned by four operators with personal "sines" as follows: Mr. Matthews—WO; Mr. Hassel—SF; Mr. Buck—AD; Mr. Fitzsimons—GJ.

9ZN has been able to actually communicate or work with stations eleven hundred miles away and has been heard a distance of twenty-eight hundred miles. The communicating records are between Chicago and Boston, Mass., 850 miles; Valley City, North Dakota, 625 miles; Houston, Texas, 950 miles; and Roswell, New Mexico, 1100 miles. The transmitting record, which was accomplisht on the low wave of 275 meters, was covered with the S.S. Olockson, L. E. Dutton, operator, when this ship was located 200 miles south of Balboa, Canal Zone, at which time Dutton copied four messages which were being sent to 9ZL at Manitowac, Wisconsin. This took place during the latter part of March.



Receiving Station of 9ZN Which Employs Some Very Efficient Receiver-units. Compactness and Efficiency are the Key Words of This Up-to-the-minute Station.

This Is the Transmitting Unit. The total Equipment Is Manned by Four Operators Expert in the Handling of Amateur Relay Traffic.

In receiving there is no difficulty in hearing most of the first, second, third, fourth, fifth, eighth and ninth district stations, most of these being audible at distances of 10 to 100 feet from the phones. Occasionally sixth and seventh district stations have been heard, notably among these being that of Seefred Brothers at Los Angeles, California. 9ZN, therefore, is able to hear amateur stations in every radio district of the United States from coast to coast. It is being heard regularly all along the Pacific coast to such an extent that Mr. Bessey, of San Francisco, has called Mr. Matthews on the long distance telephone to tell him of his having heard the signals and to arrange tests.

At 9ZN it is perfectly possible to hear ships on both oceans and in the Gulf and the 600 meter commercial stations on both coasts can be tuned in without difficulty. The receiving equipment also permits of receiving of transatlantic stations such as Nauen, Germany; Rheims, France; etc.

The radio telephone receiving record of 9ZN is that with 2XX at Ossining, New York. 2XB has also been heard while using higher power, altho their signals were not as loud nor was the modulation as good.

Some notable work was accomplisht at 9ZN on April 15 at which time a radio chess game was carried on direct with NSF at Washington, D. C. The game was played between Mr. Lasker, western champion, and Mr. Whitaker, eastern champion, these gentlemen playing at the Illinois Athletic Club of Chicago and the Washington Chess Club, respectively. These places were connected by telephone with the two radio stations. The game lasted five hours and during this time NSF and 9ZN were in continuous communication, this work being carried on the low wave. Special credit is due to Mr. Young of NSF who copied 9ZN thru extremely heavy static in addition to interference from Arlington located very close to him.

During the winter months of heavy amateur traffic continuous watches are kept nightly between the hours of 8:30 P. M. and 2 A. M. or as much later as is necessary to clear traffic. As Mr. Matthews is

(*Continued on page* 57)

* *Engineer DeForest Tel. & Tel. Co., and owner of Station 2XX.*

Robinson Brothers Radiophone Station

First Prize Five Dollars

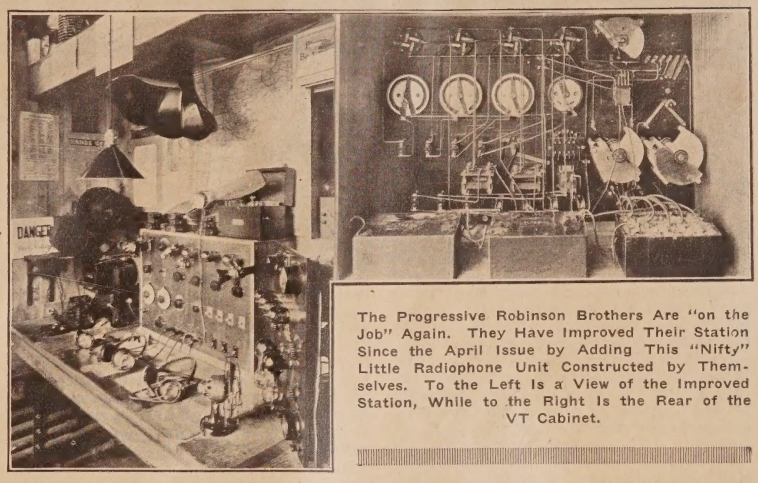
OUR Amateur friends will perhaps be interested in these new photographs of Station 2 Q R, owned by Hugh and Harold Robinson, Number 13 Walnut Street, Keyport, New Jersey, as considerable new equipment has been added since the last photographs were publisht.

The receiving set is now of cabinet type, 18 x 28", which we built up completely ourselves, using all DeForest instruments, and three stages of amplification. The photograph to the left shows the exterior of this clearly, and the photograph to the right shows the interior of this cabinet together with the wiring, etc. You will note that the receiving set is wired complete with ⅛" copper tubing, all soldered joints. You will also notice the DeForest Type "O" Radio phone set on the right with which we have succeeded in working approximately 90 miles which we think is quite a record for this little set, radiating as it does close to one ampere.

Our spark transmitting set has been improved by the addition of a special Dubilier 200-meter Condenser, and Clapp-Eastham Rotary Gap, while the aerials have been overhauled and thoroly insulated, and all unnecessary wires have been eliminated. New ground wires have been buried in various directions, and the result is we now have a normal radiation of four amperes.

We have just received a letter from Mokane, Missouri, which is over a thousand miles, stating that our signals are coming in strong there, and this was before we put in the new condenser and rotary gap, and at the time we were heard we were radiating only 2½ amperes, so we hope that we will get much better results with the new equipment.

Contributed by
HUGH AND HAROLD ROBINSON.



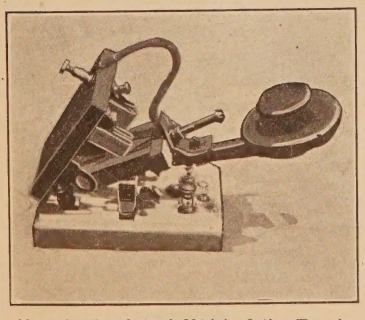
The Progressive Robinson Brothers Are "on the Job" Again. They Have Improved Their Station Since the April Issue by Adding This "Nifty" Little Radiophone Unit Constructed by Themselves. To the Left Is a View of the Improved Station, While to the Right Is the Rear of the VT Cabinet.

A Combined Aerial Switch and Sending Key

By R. U. CLARK, 3rd

The sending key and aerial switch, two closely allied instruments, have been combined, as shown here, to form one piece of apparatus in such a manner that considerable saving in material, space occupied, and time required in handling and making will be the result.

This new instrument consists of a double-pole double-throw switch, with one set of contacts and the switch blades removed or transferred to another base. The remaining set of contacts should then be mounted in place of the switch blade supports at the center of the base, and the set of blades, which are now mounted with two contacts on another base, can be bolted to small supports at one end of the original base, thus making up a quick action switch with over-head contacts.



Here Is the Actual Model of the Two-in-one Aerial Switch-Sending Key Which Mr. Clark Designed.

A home-made key can now be mounted in place of the usual switch handle, being held on the switch cross-arm by a piece of strap spring brass soldered to the back end of the key. The long bolt which runs parallel to the key arm is used to change the tension on this piece of brass spring and this in turn controls the amount of pressure required to work the key.

When changing from the receiving position at the upper contacts, to sending below, a short vertical machine screw situated just under the long horizontal bolt, used for spring adjustment, takes the strain of the sudden downward pull off of the key spring, making it act as a solid connection or handle. In making the change in the opposite direction the key arm will bear on the switch cross-arm, on which the brass strap and adjusting bolt are mounted, giving the same solid moving leverage as noted in the downward motion.

A small solid silver disk can be held to the base by three small bolts in the holes which were originally intended for wires and one of the base mounting screws to fit in. This disk acts as one contact, the other being mounted on the sending key arm in the form of a vertical adjusting bolt.

The feature of the above mentioned combination rests in the great saving in time and motion which such an instrument effects. But one quick motion is required to start sending operations. The instrument is also very neat in appearance and easy for any one to make, most of the parts being in the finished state to start with.

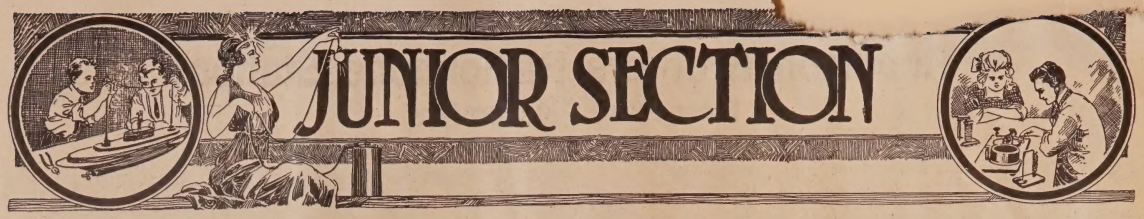
RADIO MOVIES NEXT.

British scientists who are making such rapid strides in radio telephony are working on an invention which may supersede newspaper news photography and the news reels of the movies. Telephotography—sending pictures by wire—is hardly in its infancy, when radio telephony comes up and with this new mystery of radio telephotography and its possible sensational developments. From telephotography inventors are pressing on to telecinematography, the sending of motion pictures by wire and their projection on a screen. Radio telecinematography, scientists here assert, will be a comparatively simple step.

"Some day soon American audiences will be able to sit in a picture theatre and see the daily life of Paris, Berlin or London," one experimenter predicted, "and not as it appeared to a camera several days or weeks ago but as it is at that moment. That man you see walking across the street and glancing inquisitively at the silent audience (actually at the camera), does it, and the films repeat it over and over again. In telecinematography nothing will ever be repeated exactly the same, for you will be seeing the thing itself and not a series of photographs of it.

"When radio telecinematography is perfected, its portable camera (or eye) and transmitter will go everywhere where great things are happening and audiences all over the world will actually observe them as they take place. The installation of a new American President may be actually witnessed and of course his speech heard by 100,000,000 persons. Millions may crowd to American picture theatres to see a battle actually in progress in Mexico, China, Germany and read bulletins about it in the newspapers on the way home.

"Millionaires will have dinner parties at which half the guests will be seated in London and half in New York, seeing each other on the screen and conversing with each other as naturally as if they were all in one room. Those who can afford private projections will never need to lose sight of their friends."



Junior Radio Course

Reception for the Beginner

NOW that we have studied the general elementary principles of radio concerning the ether as a road for radio waves, the generation of radio waves, the condenser (capacity), the tuning coil (inductance), dampt and undampt waves, decrement, how radio waves travel and transmission for the beginner, it is quite proper that we turn to the matter of reception for the beginner.

Radio receiving is the thing which the beginner usually starts out with. It is an easy matter to set up a simple receiving set and immediately hear signals from various parts of the country. In fact, all amateurs start out with receiving on account of its simplicity. A single wire stretched on the roof, a tuning coil, a detector, a small condenser, a 75 ohm receiver, properly connected to a ground which may consist of the house water pipe, gas pipe, steam radiator, or a plate buried in moist earth, and lo and behold the fourteen-year-old school boy has it in his power to listen to "what the radio waves are saying" in the same way and with almost the same advantage possest by the operator at the large commercial station costing thousands of dollars.

The truth of the matter is that it is altogether too easy to set up a receiving set without having to learn and pry into the whys and wherefores. For that reason our junior students should learn something of the fundamental theory concerned with receiving.

ESSENTIALS OF THE RECEIVER.

An aerial in its natural state forms an *open* oscillatory circuit, as distinguisht from a *closed* oscillatory circuit, which has a frequency of its own. Fig. 1 shows the two circuits. This oscillatory circuit is the combined result of two things, namely *inductance* and *capacity*. Then again this inductance and capacity depends upon the length and size of the wires used in the aerial, as well as the distance separating the aerial from the ground. An oscillatory *current* will not follow very easily in a circuit unless the *frequency* in that circuit is the same as that of the oscillating current. In other words, the aerial circuit must be in *exact tune* with the oncoming wave; that is to say, the wave which is to be received.

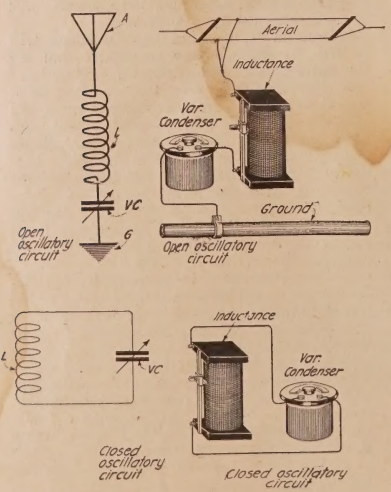


Fig. 1

The Upper Diagram Is That of an Open Oscillatory Circuit, While the Lower Diagram Is That of a Closed Oscillatory Circuit. In Each Case Is Shown the Necessary Instruments.

In order to have an effective receiver, therefore, it is necessary to have a variable inductance as well as a variable condenser so that they can be connected in series with the aerial and thus the aerial can be tuned to any desired oncoming signal wavelength. Fig. 2 shows a diagram which will explain what inductance and capacity will do in a receiving circuit. The letters A, L, VC, S and G are almost universally used as designating signs for the various instruments which go into the make-up of a receiving or transmitting set, so you are advised to learn these letters by heart as you progress in your studies in order that you may be able to recognize them at once when you see them in regular radio circuit diagrams.

A, in this case, is the aerial which is connected by the switch S_1 to the inductance or tuning coil L. By means of this switch, more or less of the inductance can be cut in or out according to the length of the wavelength you desire to receive. VC is a variable tuning condenser which is connected in series with the inductance; that is to say, when it is thus in series it will *reduce* the wavelength of the aerial more or less according to the amount of capacity turned in or out. The switch S_2 in this case will cut out the condenser completely. In this circuit, therefore, L is called the *aerial tuning inductance* and VC is called the *aerial tuning condenser.*

PURPOSE OF TUNING CONDENSER.

When the wavelength of the desired signals is shorter than the *natural or fundamental* wavelength of the aerial, it is necessary to cut out all the inductances in the circuit and open switch S_2 after which the variable condenser VC is adjusted until the correct *shorter* wavelength is obtained. Thus, you see, by cutting in the series condenser *you decrease the wavelength.*

PURPOSE OF TUNING INDUCTANCE.

Ordinarily, however, the wavelength of the signals you desire to receive is usually longer than the natural wavelength of the aerial and that is where the tuning inductance plays its important part. In this case and in order to bring the wavelength of the aerial into tune with the received signal, the condenser VC is disconnected from the circuit by closing the switch S_2, thus leaving no capacity in series with the aerial. The next move is to increase the inductance of the circuit by means of the switch S_1 until the proper wavelength is obtained.

DETECTING THE SIGNAL.

Now that we understand the part that the tuning coil and the tuning condenser play in a simple receiving circuit, let us pass on to that part of the circuit which actually *detects* the signal; in other words, the oscillating currents which have been absorbed by the aerial.

To detect the waves, therefore, it is necessary to have what is called the *detector,* or rectifier of signals, as well as the telephone receiver which will enable us to hear the *process of detection.*

There are several ways of connecting the detector and telephone receiver in a receiving system. Fig. 3 shows a simple and yet very effective way of connecting the detector D and the telephones P. The detector in this case can be one of many forms which are used by commercial and amateur stations such as Galena, Silicon and Carborundum. There are, of course, many other types of detectors besides crystals, for instance the *Marconi magnetic detector,* the *electrolytic detector* and the *audion or vacuum tube detector.* We shall speak of these in detail in a future lesson.

THE DOUBLE CIRCUIT SYSTEM RECEIVING.

Up to now the receiving system under study has been of the simple single circuit type, which, altho fairly effective in amateur work, is not always very sensitive for

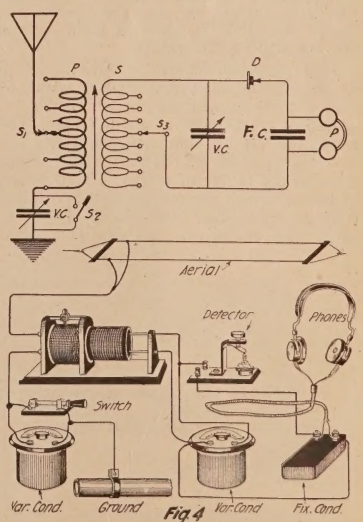


Fig. 4

This Receiving Circuit Uses a Loose Coupler or Tuning Transformer. In This Case There Are Two Distinct Oscillatory Circuits, and Both Must Be In Tune With the Received Wavelength.

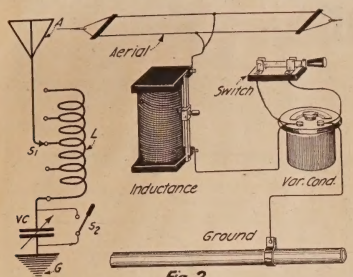


Fig 2

In This Case We Have a Variable Inductance and a Variable Capacity, Both of Which Play an Important Part in a Receiving System.

other classes of work. There is, therefore, a second system of receiving which is widely used and which is called the two circuit receiver employing the well-known tuning transformer, or so-called loose-coupler. In this method there are two distinct oscillatory circuits *both of which must be in tune with the received wavelength.* Fig 4 shows a circuit of this kind where P is the primary and S the secondary of the tuning transformer. The arrow between the two indicates that the two circuits may be either closely or loosely coupled. In this case, the primary circuit consists of the aerial having an inductance adjustable by means of the switch S_1 as well as the tuning condenser VC which may be either open or closed by means of switch S_2. The secondary circuit consists of an inductance coil with a variable condenser connected across it by means of which the wavelength of this second circuit can be adjusted, thru switch S_3, with the primary circuit, the latter, of course, having first been tuned to the desired wavelength.

In our next lesson we shall explain what is assumed to take place from the time an electro-magnetic wave signal strikes the aerial until it is heard by the operator listening with the telephone receiver.

QUESTIONS FOR THIS LESSON.

1. What two important conditions are necessary in a radio circuit in order to produce an oscillatory circuit?
2. What instrument is used in a receiving circuit to *shorten* the wavelength; what instrument will *increase* the wavelength?
3. What is the difference between an open circuit and a closed circuit? Take your pencil and draw sketches of the two.
4. Why is the loose-coupler receiving tuner different from the single tuning coil?
5. Draw a diagram of a single circuit receiver and of a double circuit receiver. Memorize them so that you can draw them from memory.

A WORD OF ADVICE TO BEGINNERS.

By the way, boys, there is one important thing you should remember as you progress along in your study of the principles of radio communication. The reading of this course, or of a half dozen other courses, for that matter, will not do you very much good as far as *remembering* is concerned, unless you *actually practise what is preached to you.*

By this we mean that as far as possible you should secure the necessary instruments under discussion and personally see for

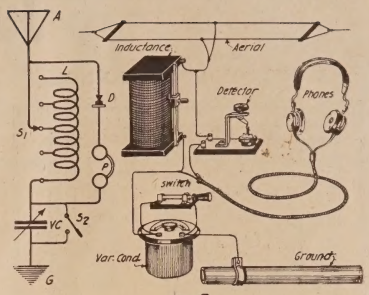


Fig. 3

A Simple Method of Connecting Detector and Telephones to the Variable Inductance. To the Left Is the Wiring Diagram, to the Right the Instruments.

yourself just what takes place when instruments are connected or disconnected in a radio sending or receiving circuit. See what happens when you increase or decrease the number of turns in a tuning coil or when you increase or decrease the space between condenser plates. Experiment likewise with the detector. Change the manner of connecting the various instruments. Try all sorts of combinations of hook-ups in addition to the ones taught you. Keep on doing this until you are familiar with the hook-ups that will *actually work* as well as those that will not work. Never cease to experiment for that is the greatest and most fascinating part of the game. Not only that, but that is the real way to learn —remember that, boys.

Dictionary of Technical Terms Used in Radio Telegraphy and Telephony*

L Aerial—See Inverted L Aerial.

Lag—Is present when maximum current does not occur until some time after maximum E.M.F. (Electro Magnetic Force) See Hysteresis.

Laminated—Composed of a number of thin plates placed one on top of the other.

Lapwound—A type of winding of drum armatures in which the inter-connections are arranged so that winding is done in loops, the front connections lapping backward toward where the back connections commenced.

Latitude—Distance North or South of the geographical equator, measured in degrees, minutes and seconds. See *Longitude.*

Law of Magnetism—Like poles repel, unlike poles attract. The same law holds good for Static Electric Charges.

Lead—Pb. Plambum. A. W. 205.35. S. G. 11.35. Mlt. Pt. 618° F. Val. 2. Chem. Eq. 102.67. Elec. Chem. Eq. .001,071,6, S. R. 20.38.

Lead (Pronounced Leed)—Occurs where maximum current is reached before maximum E.M.F.

Leading—In or Lead—in Insulator. Any form of insulator used for passing down-leads of aerial through roof or walls of operating cabin.

Lead Monoxide—Pb0. Litharge. Brownish-yellow substance.

Lead Peroxide—Pb02.

Leads—Wires conveying or "leading" a current from point to point in a circuit.

Lead Sulphide—PbS. See Galena.

Lead Sulphate—PbS04. Also called Anglesite.

Leaf Tellurium—See Nagyagite.

Leclanche Cell—Single-fluid cell. Consists of a porous pot containing a carbon rod packed round with Manganese Dioxide and crushed with a zinc rod placed in a glass retainer partly filled with a saturated solution of Salammoniac (Ammonium Chloride). Very slight polarization. E.M.F. 1.5 Volts. Internal resistance varies.

Length of Aerial—An aerial is measured from any of its extremities to point of connection with instrument, the measure of one component wire alone being taken into consideration. In a T Aerial only half of the horizontal span must be added to the length of downleads. In Inverted L Aerial total horizontal span must be added to downleads. In Umbrella type, length of aerial is taken as length of one radial lead added to down lead.

Lenz Law—An induced current always tends to stop the current which produces it.

Leyden Jar—A condenser in the form of a flint glass jar with lower portions of its inner and outer surfaces coated with tinfoil. This tinfoil is referred to as the "Coatings."

L. F. C.—Low Frequency Current.

Li—See Lithium.

Light—Ether vibrations varying between 400 billions per second producing waves 271 ten-millionths of an inch in length, and giving Red Light up to 750 billions per second producing waves of 165 ten-millionths of an inch in length, giving violet light. Faster or slow vibrations produce waves not visible to the human eye. Shorter waves are called Ultra-violet rays, while those immediately above the Red rays are known as Infra-red rays. The speed of light waves is identical with that of other electro-magnetic waves and Electricity, and is 186,000 miles per second.

Like Charges—Repel. See Law of Magnetism.

Line—Electrical Engineers refer to outgoing, or positive wire, as line, and the return wire as earth, which itself is frequently used for this purpose.

Line of Force—Is a curve so drawn in a magnetic field that the direction of the Tangent at any point is direction of Magnetic Force or Field Intensity at that point.

Liquid Barretter—Barretter in which the loop of Wollaston wire is substituted by fine tube of high-resistance liquid, or in another form has two ends of very fine platinum wire dipping into a liquid.

Litharge—Pb0. Lead Monoxide. Also known as Massicot. Paste of negative plate of accumulator. Yellowish brown in color.

Lithium—Li. Lightest known solid. A. W. 6.98. S. G. 0.59.

Lithanode Ceill—One having its negative plate pasted with Litharge.

Loadstone—A peculiar iron ore having the natural properties of a magnet. Also called Magnetite. Found in Magnesia, in Asia Minor.

Local Action—Or Polarization, as it is called, is produced in a cell by impurities in the zinc acting upon each other and thus setting up a number of minute currents over all the immersed plate. Amalgamation with mercury tends to check this. In Accumulators is due to the action which takes place between the lead of positive and the coating of Lead Sulphate.

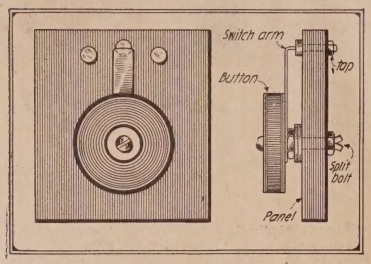
Locus—Path of a movement. Graphically represented by a Curve.

Lodge Disc Detector—An Imperfect Contact Detector. Consists of a steel disc rotating with its sharp knife edge just touching some mercury having a film of oil on it. Oscillations passing through

(*Continued on page* 57)

* *This dictionary started in our March issue.*

A BUTTON SWITCH KNOB.



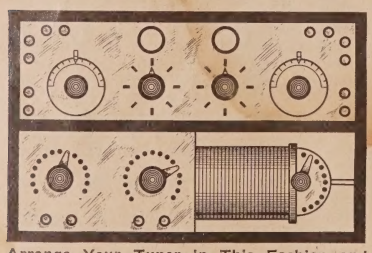
Buttons Such as Those Used on a Sailor's Pea-coat May Be Employed to Advantage For Switch Knobs.

I believe that I have devised a neat and inexpensive switch knob. It is made as follows: A composition button must be procured from an old overcoat, (the large buttons from a Navy "P" jacket make very excellent ones). The button is drilled through the center and a bolt passed through it and also through the switch lever. A nut is placed between switch arm and panel and serves to hold the arm and button together. The end of the pivot bolt is split with a hack saw and then slightly spread to prevent the nut from coming loose.

Contributed by D. C. BROCKWAY.

ARRANGING THE LOOSE COUPLER IN A PANEL SET.

Amateurs who would like to use their loose coupler in a panel set, but who hesitate to mutilate it in order to do so, may be interested in the following scheme: The top and base of the coupler are removed. A wooden cabinet is made similar to the one used with the "double deck receiver." The lower part is made just large enough to contain the loose coupler, the panel of the coupler being flush with the cabinet. A bakelite panel is fitted in the upper part for the other instruments of the set. The size of the upper panel of course depends upon



Arrange Your Tuner in This Fashion and You Have a Neat Appearing Panel-Cabinet.

the size and number of instruments it is desired to attach thereto. For a larger set the cabinet could be made longer, with a longer upper panel and an additional small panel in the right hand side of the lower part.

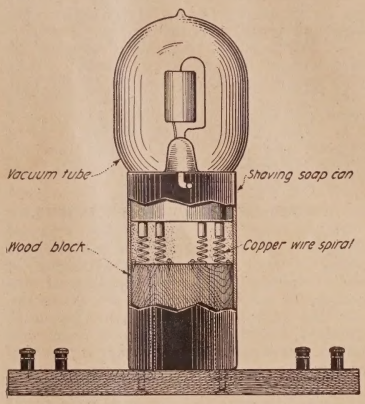
Contributed by
FRANCIS S. WILLIAMS.

REDUCING COST OF V. T. RECEPTACLE.

This is a sketch of a novel vacuum tube receptacle made from a Colgate's shaving-soap can. It so happens that the tube just fits snugly into this can, so snugly in fact that there needs to be no crook in the slot to keep it in place. The copper wire spirals shown in the diagram are made of bared wire of twenty-four or so gauge. The slot is made by cutting out a narrow strip of metal at the top of the can. The drawing is otherwise self-explanatory.

The soap can is non-magnetic and nicely finished, and makes a good-looking article.

Contributed by
ELLSWORTH McELWEE SHAFTO.



Reduce the Cost of Vacuum Tube Sockets by Making Use of Discarded Shaving Soap Cans.

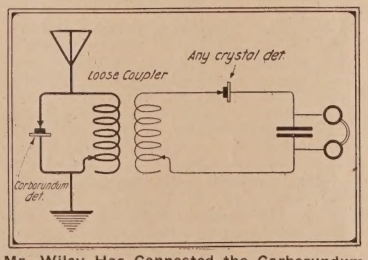
SIMPLE STATIC ELIMINATOR

For those of us whose experiments are still confined to the crystal rectifier and who live in the Southland where King Static will soon hold forth, the following described simple static eliminator may prove of interest.

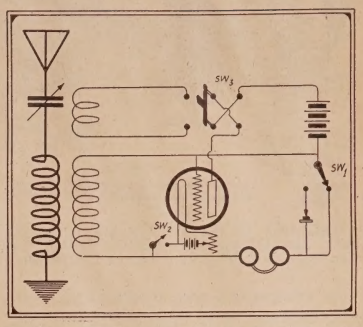
A carborundum detector is shunted directly across the ground and antenna terminals of the loose coupler and after adjusting the usual secondary detector in the ordinary manner, and when a signal is heard through the static, the shunted detector is cut in and adjusted until a certain point will be found where the reduction of signal strength is more than compensated for by the decrease in static.

With this method there is, of course, a probability of cutting down both signal and static, depending upon the point selected on the extra crystal and the strength of the received signal. There will always be a reduction in signal strength when the extra crystal is functioning properly, but the writer has made impossible signals entirely readable in this manner. After experiment it will be found that certain long wave stations respond much more readily than others, due perhaps, to differences in decrement.

Contributed by LEO G. WILEY.



Mr. Wiley Has Connected the Carborundum Detector Between Aerial and Ground and Thereby Reduced Static.



By Means of This Circuit This Experimenter Secures Four Individual Hook-ups.

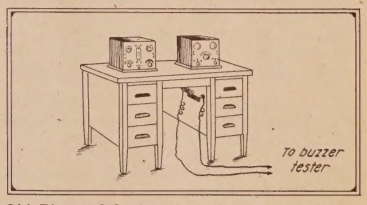
A FOUR-IN-ONE CIRCUIT.

Are there not many amateurs who would like, through the employment of a few switches, to have the four circuits: Audion Detector, Crystal Detector, and Audion Amplifying and Crystal Detecting for Dampt Waves, and Audion Detecting for Undampt? Then cast your eyes upon this little paragraph and the accompanying diagram, dig up a few switches, wire it as per diagram, "pack up your troubles in your old kit bag, and smile, smile, smile!"

By closing switch number one on the contact leading to the detector, the usual crystal detector circuit is in use. Throwing the detector out of the circuit by disconnecting the switch arm which is put on the other contact then, and subsequently closing switch number two (a single pole single throw) the audion detector circuit is in, switch number three, of course, being closed so that the "B" battery and the plate are connected. By moving the contact arm of switch number one, so that it is connected to the crystal detector, and having the phones connected to the filament of the audion, the Audion Amplifying and Crystal Detecting circuit is being used.

And then, the greatest circuit—the undampt—is in force by simply throwing the double pole double throw switch (number three) to the tickler side of the switch, disconnecting the crystal, and connecting the phones to the filament.

Contributed by C. V. GOEBEL.

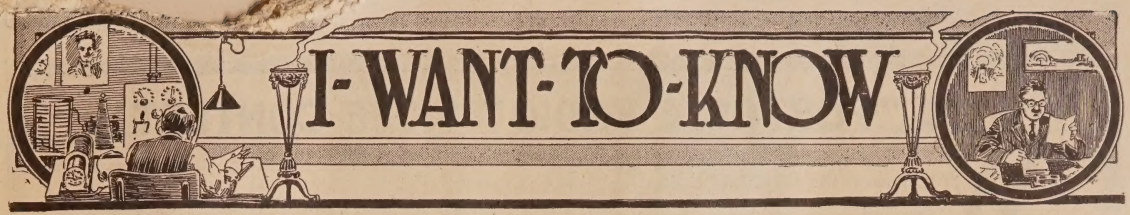


Old Piece of Spring Brass Used in the Form of a Strap Key and Placed in the Above Position With Test Buzzer Makes a Handy Way of Adjusting Crystals.

BUZZER TESTER.

When you wish to have your two hands free for other purposes and yet wish to test out your crystal in some convenient manner, arrange a spring which will make contact for your buzzer tester and place it on the right or left side of your desk or table, as shown in sketch. When you wish to "test out" simply move your knee over to the spring contact. The movement is hardly noticeable and this fact can be employed to mystify some of the "rubber-neck" onlookers.

Contributed by P. EX.



THIS Department is conducted for the benefit of our Radio Experimenter. We shall be glad to answer here questions for the benefit of all, but we can only publish such matter of sufficient interest to all.

1. This Department cannot answer more than three questions for each correspondent.
2. Only one side of the sheet should be written upon; all matter should be typewritten or else written in ink. No attention paid to penciled matter.
3. Sketches, diagrams, etc., must be on separate sheets. This Department does not answer questions by mail free of charge.
4. Our Editors will be glad to answer any letter at the rate of 25c for each question. If, however, questions entail considerable research work, intricate calculations, patent research, etc., a special charge will be made. Before we answer such questions, correspondents will be informed as to the price charge.

You will do the Editor a personal favor if you make your letter as brief as possible.

SOUND MAGNIFIER

(182) W. A. West, Nelsonville, O., writes:

Q. 1. Can you give me information regarding the use of vacuum tubes for increasing sounds, such as phonographs? Where can I buy a complete arrangement of this kind?

A. 1. An instrument on the market known as the *Telemegaphone* is designed to amplify various sounds with great volume whereby the sounds may be easily heard at considerable distances in quiet surroundings. This instrument will also amplify music and the voice as well as radio signals. We suggest that you write to the Magnavox Co., San Francisco, Cal.

RADIOPHONE HOOK-UP

(183) Charles Porter, Jr., East Orange, N. J., writes:

Q. 1. Will you kindly give a hook-up for a radiophone using two Marconi vacuum tubes, telephone transmitter, modulation transformer, tuning transformer, 200-volt plate battery, and suitable capacities?

A. 1. A suitable diagram appears in this section.

Q. 2. How far should a set of this kind transmit?

A. 2. Under proper conditions a set of this type should transmit at least twenty miles, possibly more; in fact some prominent amateurs have covered many times this distance.

Q. 3. How can I make rectifying tubes to change alternating current from A. C. to D. C. and use it for high plate voltage?

A. 3. It is hardly practical for the average amateur to build his own rectifying tubes, as efficient ones can be bought at a reasonable price. We suggest that you consult a nearby radio supply house and ask for the *vacuum rectifier tube* which permits you to rectify 110-volt, 60-cycle alternating current to direct current, providing, of course, you obtain a transformer so that it will step up sufficient current for the plate as well as step down sufficient energy to light the filament. An article on this timely subject will probably appear in the next issue.

SOFT VERSUS HARD VACUUM TUBES

(184) Nathan Johnson, Bridgeport, Conn., asks:

Q. 1. What is meant by the expressions *soft* and *hard* vacuum tubes, and how does each differ?

A. 1. These expressions are employed to distinguish vacuum tubes having high vacuum as compared to those having a low vacuum. *Hard vacuum tubes* are not subject to "blue glow" characteristics when subjected to high plate voltages. *Soft vacuum tubes,* on the other hand, often give blue glows at comparatively low voltages, in other words they ionize. Soft vacuum tubes are generally used as detectors in receiving systems while hard vacuum tubes are employed as amplifiers and oscillators in both receiving and transmitting circuits. Soft bulbs may be employed in cascade amplification circuits providing the inductances of the primary and secondary of the amplifying transformers are variable, in fact this class of bulbs will often give better results as detectors than the hard bulbs.

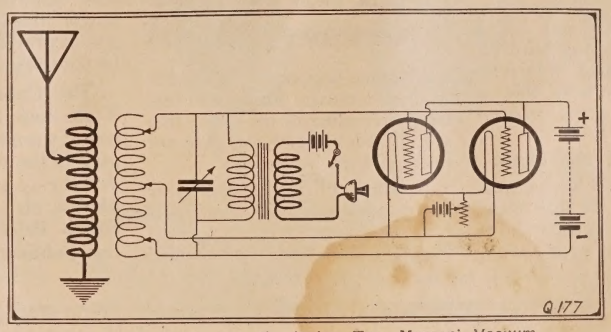


Diagram of Hookup Employing Two Marconi Vacuum Tubes in Connection with a Radiophone Set.

Q. 2. What should the resistance of the grid leak be when employed in regular receiving circuits?

A. 2. The resistance of grid leaks may vary from 2000 ohms to 4,000,000 ohms (1,000,000 = 1 megohm). Regular manufactured grid leak resistances may be purchased from radio supply houses. These are usually made in the form of small graphite rods which may be plugged into receptacles similar to fuse bases.

RADIOSON ELECTROLYTIC DETECTOR

(185) William Maier, Philadelphia, Pa., writes:

Q. 1. Kindly publish in your "I-Want-To-Know" page how the *Radioson* detector is constructed and whether it is possible for me to make one.

A. 1. The *Radioson* is in reality an electrolytic detector, having a special very fine Wollaston wire arranged in such a manner that it does not require adjustment. It would prove rather difficult for you to attempt to build this detector and we suggest that you purchase it direct from the manufacturers, Electro Importing Co., New York.

SIZE OF AMATEUR AERIAL

(186) G. Masterson, Pocatello, Idaho, asks:

Q. 1. How long should an L antenna be so that it will be suitable for transmission on the amateur wavelength of 200 meters?

A. 1. An aerial suitable for 200 meter work should be approximately 200 feet long and not more than 40 feet high of four No. 14 aluminum or phosphor bronze wire for the inverted L type and not more than 135 ft. long and 40 ft. high for the T type. Read the article "Concerning Aerials" which appears in this issue, pages 18-19.

FORCED OSCILLATIONS

(187) Roy Howard, Cleveland, Ohio, writes:

Q. 1. Can you tell me why I am able to hear signals whether or not my antenna is connected to my receiving instruments?

A. 1. The reason why you can hear signals when your aerial switch is either closed or open is that you are evidently situated near a powerful transmitting station so that sufficient forced oscillations are picked up by the receiving instruments directly being of sufficient energy to actuate them.

SALARIES OF OPERATORS.

(188) C. G. Mills, Sherbrook, Quebec, Canada, wishes to know:

Q. 1. What is the pay of the average radio operator on board ocean-going vessels of the American Merchant Marine?

A. 1. The pay of the senior operator on American merchant vessels is $125 a month, while the pay of a junior operator is $100 a month. In addition to this is included board and room which may be said to be equivalent to another $40 a month.

RECEIVING EUROPEAN STATIONS ON A LOOP.

(189) Eugene Brick, Rochester, New York, asks:

Q. 1. Is it possible to receive long wave European radio stations by making use of an indoor loop, and if so how many stages of amplification are necessary?

A. 1. Yes. It is possible but it is not an easy matter, as it involves considerable knowledge of receiving circuits in connection with vacuum tube amplification. It has, however, been accomplisht by experimenters making use of six-foot loops and six stages of amplification, three stages of radio frequency and the other three stages of audio frequencies, one of the vacuum tubes acting as a detector.

SHORT WAVE RECEIVING SET.

(190) V. L. Chamberlin, Pontiac, Mich., asks:

Q. 1. Where may I secure information concerning the short wave receiver described on page 467, of the March issue?

A. 1. We suggest that you write to Mr. S. Cohen, 281 Wyona Ave., Brooklyn, N. Y.

$100 "PORTABLE RADIO" PRIZE CONTEST*

WE are pleased to announce a third $100 prize contest entitled **"Smallest Portable Radio Outfit".** Our Radiophone contest just having closed successfully, we believe that our readers would be interested in the new contest, of which we have the following to say:

A great many amateurs,—if not the majority,—are intensely interested in a small portable outfit that can be taken about when visiting friends, when going away for week-end parties, for camping and a great many other purposes. Particularly during the summer and fall a good portable receiving outfit is greatly desired and highly prized, as we have been able to satisfy ourselves from experience.

Requirements of the Outfit

THE outfit must have means for tuning. It may have one or more detectors. It should have means for receiving messages by sound, which may be the usual set of telephone receivers *or something better.*

Rules for the Prize Contest

THE set to be described may be of the usual receiving type. Vacuum type, electrolytic or crystal detectors may be used at the option of the builder. There should be some new features embodied in the outfit that are not known now, or have not been publisht heretofore.

It is also obvious that insofar as this contest is conducted chiefly to bring out NEW ideas, commercial radio outfits are excluded from this contest. It is necessary to state what instruments are used, and if some of the instruments have been bought, the make must be stated. A good diagram of the connections neatly executed in ink is to be furnished. A good photograph, not smaller than 5x7 inches giving at least two views of the set is necessary. A photograph of the builder is also required

PRIZES OF $100 IN GOLD

First Prize	**$50.00**
Second Prize	**25.00**
Third Prize	**15.00**
Fourth Prize	**10.00**

More than one outfit may be entered by contestants. The contest is open to everyone, radio clubs included, except manufacturers of wireless apparatus. The manuscripts should not be longer than 1500 words; 1000 words preferred. All prizes will be paid upon publication.

The Contest closes in New York July 12th, and the first prize winning article will appear in the August, 1920, issue. Address all manuscripts, photos, etc., to Editor Portable Radio Prize Contest, care of this publication.

** For full and more complete information see May issue*

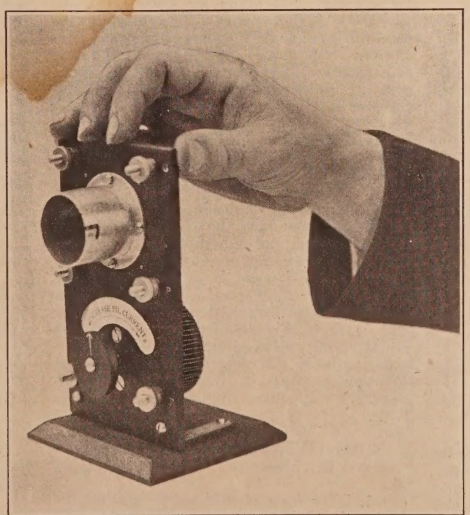
A Control Panel for That Portable Set of Yours*

THE striking feature of this interesting little audion control panel is its unusual size. As may be seen in the accompanying photograph, it fits in the palm of the ordinary hand. This compactness becomes a desirable factor when the amateur is prest for space, be it on his operating table or in connection with the receiving panel.

The instrument, which is manufactured by a Long Island radio company, is made as well as some of the most expensive on the market. The panel is made of grade XX Bakelite Dilecto and is six inches high by 3½ inches wide. The audion socket is of the standard Navy type, being made of hard aluminum spun to shape and so mounted that the bulb will always make proper connections, and will never stick. The filament rheostat is of the well-known Navy cage type which allows plenty of heat radiating surface which is not generally found in rheostats manufactured for amateur use. An open circuit point on the rheostat allows the filament battery to be disconnected when not in use. The instrument is made wholly of non-magnetic materials, and all parts on the front of the panel are heavily nickel plated. The rheostat is wound in such a manner that its turns bear a non-inductive relation to each other.

All four terminals on the bulb socket are brought out to binding posts as well as the two terminals on the rheostat allowing for any possible combination of circuits. This unit makes an ideal audion detector set for the radio experimenter.

Now that vacation days are at hand a suggested use for an instrument of this type would be to include it in the construction of an experimental *portable set.*



Compactness is the Keynote of This Interesting Little Audio Control Panel. Might Be Called "Vest Pocket Edition" of Some of the Larger Units.

** Photo courtesy of The Radio Service and Mfg. Co.*

NAVY AFTER RADIO MEN; FREE RADIO SCHOOL.

The Bureau of Navigation has announced that intelligent young men who desire to enlist in the radio branch of the Navy no longer need have a working knowledge of wireless telegraphy. Commander F. H. Poteet, in charge of the New York City Navy recruiting station at 34 East Twenty-third Street, stated that there are 490 licensed amateur radio operators and hundreds of other promising applicants whose education and ability indicate that they will be able to complete the thirty-two week course at the Navy Radio School at Great Lakes, Ill.

The graduates are rated as radio electricians, second or third class, depending upon the proficiency they have shown. The graduates are assigned to general service, being attached to either warships or shore stations. Besides the many stations along both coasts of the United States the Navy owns and operates modern stations in Alaska, Isthmian Canal Zone, Cuba, Virgin Islands, Porto Rico, Hawaiian Islands, the Philippines and China.

Additional information concerning the well paid and interesting naval radio service may be secured by applying at the Naval Recruiting Office of any large city or town in the United States.

Read the important announcement on page 15 concerning RADIO NEWS.

ALFRED ... Bellingham, Wash.

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2400 Broadway DESK 24 New York

The Importance of the Wavemeter

(*Continued from page* 12)

of 7. This difference in the new readings on C *when G is at 29 as before* is too much for the "drop" of 30 to 29 on G so we are warned in time. Thus we see very readily that the tuning is becoming broader and no closer coupling in the transmitter should be permitted. In fact, a slight loosening up will not hurt.

By following the above procedure the radio experimenter can utilize his transmitter energy to the best advantage and at the same time keep out of trouble.

Editor's Note: Read this article very carefully two or three times and follow the author's explanations very carefully when you tune your transmitter. A word to the "unwise" is not often sufficient. Too much cannot be said and written concerning this important subject.

Experimental Wave Tester for Receiving

(*Continued from page* 13)

holder can be of any pattern suitable for carborundum, though the shape shown in Fig. 1 has been tried with success and would be recommended. Use hard springy brass or phosphor bronze of a light gage for the purpose.

The inductances: Wind into the slot in the former for the exploring coil 20 turns of "Litzendraht" wire. It can be wound into this slot quite carelessly, that is there will be no need to lay the turns neatly side by side, but merely bundled together in the slot. The ends must be brought out and connected to the two terminals provided for the purpose. The variometer coils will have a much larger value, and, of course, must also be wound with "Litz" wire. Wind the inner coil with six layers of wire with 50 turns in each layer, making in all a total of 300 turns. Each layer must be spaced from its neighbor by means of three turns of fairly stiff drawing paper. Do not shellac the paper nor the winding, as, in so doing you will be defeating your object by again increasing the capacity between layers. The ends of each layer can be kept in place by means of tape or ribbon slipt in under the last few turns, and drawn back tight. The whole coil should be taped when complete and can then be shellacked.

The outer coil must be wound with twelve layers of 50 turns each of the same wire, which will total 600 turns. The method of winding, and treatment generally is the same for this as with the inner coil. The inductances, when complete, will then be as under:

Exploring coil		20 turns
Variometer	inner coil	300 "
	outer coil	600 "
Total		920 "

When complete, the total inductance of this combination, can be measured with a wavemeter and it will then be quite a simple matter to calculate the values required for the four condenser units which are used in parallel with the inductances to give the desired ranges of wavelength.

The capacity of any unit condenser, can be readily found by the formula

$$C = \frac{A}{4\pi T\ 900{,}000} \times K$$

where A = Area in square centimeters of the dielectric covered by plates.
T = Separation of plates or thickness of dielectric in centimeters.
K = Dielectric constant.

(*Continued on page* 36)

NEW ORLEANS RADIO APPARATUS and SUPPLIES
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Send 3c stamp for lit. erature which is sure to interest you.
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SKINDERVIKEN TRANSMITTER BUTTON
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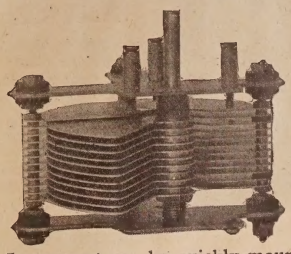


The New
Arco Variable Condenser

We offer Radio Men something out of the ordinary in variable condensers. This new model is a step ahead of its rivals in that the plates are made of aluminum and heavier than those found in the average condensers. The rotary plates are rounded as one end, not the usual semi-circular type, thus affording a straight line capacity, which is a very valuable feature in Wave Meter work. The zero capacity in an instrument of this type is considerable lower than that of usual condensers.

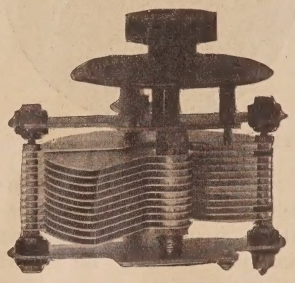
Shaft on which rotary plates are mounted is carefully machined from tool steel. Instrument can be quickly mounted in case or behind panel.

Made in two capacities, furnished unmounted only, with or without dial of fine black moulded composition and bakelite knob.

Backed up by Radisco guaranteed quality of workmanship and low price.

Capacity	Unmounted	With Dial & Knob
.0005 mf.	$5.00	$6.00
.001 mf.	6.25	7.25

Shipping weight 2 pounds.



Prices quoted do not include carrying charges to Pacific Coast or duty paid for Canadian use.

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Kelly & Phillips Electric Co.,
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CHICAGO, ILL.
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Klaus Radio Co.

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McKEESPORT, PA.
K. & L. Electric Co.,
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A. H. Corwin & Co.,
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Radio Electric Co.,
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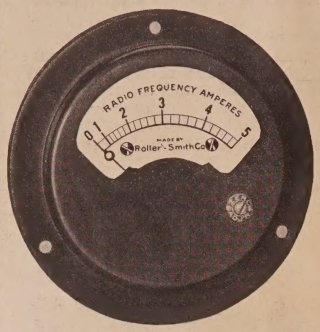

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DODGE'S INSTITUTE D Street, Valparaiso, Ind.

(*Continued from page* 34)

The result will be in microfarads. Having an approximate value of both inductance and capacity in the circuit a rough approximation of the wavelength range for each condenser unit can be obtained by the use of the formula

$$\lambda = 2\ \pi \times 300 \times \sqrt{L\ C}$$

where $\pi = 3.1416$.
L = Microhenries.
C = Microfarads.

These calculations will be of considerable assistance when building the condenser units, but when complete, the instrument must be carefully calibrated with a standard wavemeter and the wavelengths either marked directly on the scale, or curves must be plotted, showing the reading of variometer for each individual condenser unit.

The operation of the wavetester is simplicity itself. Supposing you require the adjustment of your receiver for Nauen (POZ). Referring to your call book you will find the wavelength of this station to be 12,600 meters. Set the wavetester pointer to this value, move the small three-way switch to contact connecting the buzzer, and tune up to the buzzer signal as you would when receiving a radio signal ordinarily.

In conclusion, the writer would like to point out that in the past far too many experimenters have relied upon guesswork for their tuning and hopes that this article, even if only to a few, will pave the way to further research and experiment upon safer ground.

Construction of a Magnetic Aerial Switch

(*Continued from page* 17)

The instrument is operated on 110 volts A.C. or D. C. and does not draw an excessive current. It also has the added advantage of being inexpensive. If any difficulty is experienced with it the author suggests writing to him, c/o RADIO NEWS.

An International Alphabet

(*Continued from page* 17)

placing three dashes one after the other. And where there are dots in between the horizontal dashes we place just that many vertical dashes between the horizontal dashes as there are dots. To understand it better, look up alphabet as it is shown herewith.

This method is applicable to the numbers, punctuation marks, and also abbreviations are governed by the above rules, but as the Arabic numbers as well as the punctuation marks are almost universally used, it is better to write them in the ordinary way.

APPLICATIONS FOR RADIO CALL LETTERS.

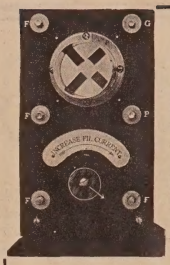
Applications for radio call letters should be made to radio inspectors and collectors of customs at the different ports and not to the office of the Bureau in Washington. Applications for vessels should be made at the time application is made for the official number and signal letter and not before such time.

HELP! HELP!

What is the difference between an operator and the girl who makes frankfurters?

One sends messages and the other mends sausages!

—*P. F. Geagan.*



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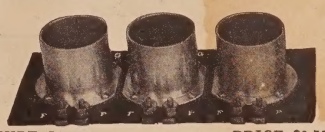
If your dealer cannot supply you, order direct.



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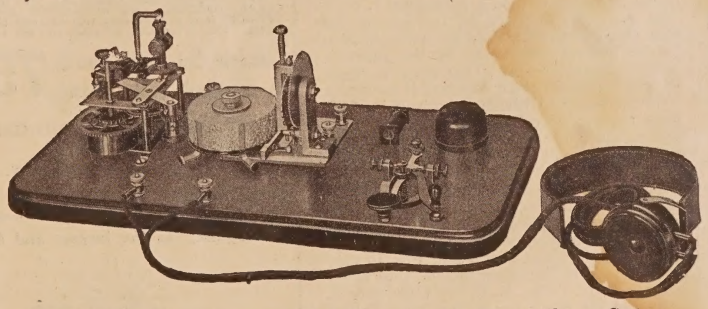

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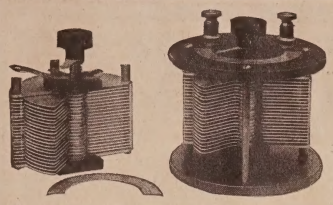

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Three Styles, No. 1. Panel, No. 2. Open Type as shown, No. 3. Fully Encased. Anti Profiteer. Less than pre-war prices. Fully assembled and tested.

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Style	No. 1	No. 2	No. 3
43 Plates,	$3.00	$4.00	$4.25
23 "	2.50	3.50	3.75
13 "	2.25	3.25	3.50
In Canada	25c	additional.	

Money back if not satisfied. Just return condenser within 10 days by insured P. P.

These condensers are made by a watch mechanic schooled in accurate workmanship. Personally we will need no introduction to Amateurs who have "listened in" for "time" and "weather" from 9. ZS.

Postscript.

We shall have to claim an even wider distribution of the "ILLINOIS" this month. Instead of placing our limits from the Penobscot to the Golden Gate, we will say from Shanghai to the Zuyder Zee. Commercial and Naval Operators have discovered us, and we expect Uncle Sam's Navy and new Merchant Marine will soon be large users of our "best ever" "ILLINOIS."

We again thank our friends for their generous words of appreciation.

You will note a slight increase in our price list, on the "mounted" styles only. This will be effective from May first. The fact is we could not quite "get by" with our first prices.

The "Star Spring" feature of our design meets with great favor. We shall make this the subject of application for Patent, as we think it marks a step forward in the construction of Variables. It has two important functions. It keeps the plates accurately and permanently centered; without "endshake"; and provides sufficient friction to hold the "rotor" at any setting without liability of its dropping from its position by the unbalanced weight. It makes the Condenser, in this respect, as reliable as the much more expensive "balanced" type.

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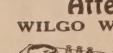

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About Aerials

(*Continued from page* 19)

rectly above the desired spot the tension on the string is suddenly let go whereby the kite will drop on the roof below. It is then the job of your friend to go to the next building and pull in the cord to which has previously been fastened the aerial wires. Ordinarily the cord will be strong enough to accomplish this and in this way the person on the station roof can slowly uncoil the wires so that kinking or entangling may be avoided.

The erection of suitable masts for aerials will not be described here, as several excellent articles on this subject have recently been publisht in fact, one appeared in the last issue. A word or two, however, may be said concerning the spreader. This should preferably be of some hard, well seasoned wood, either round or square and well painted to preserve it. If procurable, bamboo rods of two inch diameter are quite suitable owing to their lightness in weight and comparative strength. If properly guyed by means of a stout tarred rope as shown in Fig. 8, the aerial will be prevented from undesirable swinging or entangling of the wires even during severe wind storms.

PRACTICAL MEASUREMENTS.

Since this article is intended for the beginner who is not familiar with the mathematical end of radio measurements, we confine ourselves to a few simple, general rules which may be followed in the absence of a wave meter. The natural period or wave length of an antenna may be roughly determined from its physical dimensions. For instance, the wave length of an umbrella aerial as well as a horizontal L or T type may be calculated by multiplying the total length from the free end straight thru to the ground connection by the approximate constant of 4.2. This gives a result in feet so that in order to bring it to meters it is necessary to divide the result by 3.25. This manner of calculation, however, does not consider the many and various conditions which apply to individual installations, and as previously mentioned, is rather a crude method. If a wave meter is at hand, or can be borrowed, it is much easier and certainly more accurate to measure the radiated wave length directly. The two practical charts shown at Fig. 9 and Fig. 10 may be employed by the experimenter with fairly good results. One is for a four wire L type and the other for a four wire T type aerial where the length to be considered is from the extreme free end to the ground without taking additional inductances, such as oscillation transformer or other coils as part of the circuit, into consideration.

THE GROUND CONNECTION.

To the city dweller a suitable ground may be obtained by soldering or otherwise permanently connecting a lead to either a water-pipe or steam radiator system. In fact, it is a good rule to secure connections on both. So-called ground-clamps may be obtained specially for this purpose from any radio supply house. In the country or isolated districts the permanent ground may be establisht by burying about two hundred square feet of galvanized sheet iron in a preferably moist section and at a ground depth of about six or more feet. To this must, of course, be soldered or firmly attached a heavy copper wire which is lead to the instruments. A more certain ground may be obtained by emersing a long pipe or other piece of metal in a small lake or swamp.

And, now, boys, a few parting words. Follow out as closely as you can instructions contained in this article, and providing you

(*Continued on page* 40)

Radio Diagrams and Formulae in Loose Leaf Form

The publishers of the CONSOLIDATED RADIO CALL BOOK have completed the preparation of diagrams and instructions on:—

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Table giving the value of LC (Product of Inductance and Capacity) for wavelengths from 300 to 20,000 meters. Inductance in Microhenrys.....No. 100

Table same as above but with Inductance in centimeters.....No. 101

Schematic Wiring Diagram of Signal Corps Type SCR-68 Radio Telephone Transmitting and Receiving Set.....No. 51

Schematic Wiring Diagram of Type CW-936 (Navy Submarine Chaser) Radio Telephone and Telegraph Transmitter and Receiver. No. 52

Schematic Diagram of Type S.E. 1100 (Navy Flying Boat) Radio Telephone and Telegraph Transmitter.....No. 53

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(*Continued from page 38*)

employ due care and intelligent planning, coupled with judicious advice in the installing of your transmitting and receiving instruments, you will go a long way toward a proper start in your radio career.

The President's Special

(*Continued from page 23*)

ator, brushing back a 'phone from one ear in order that he might hear the conductor. "Guess this trip will make history, eh?"

"You said it," the conductor was emphatic. "Getting anything?"

"Funny thing, but everybody must have quit," remarked the operator, complacently, "Haven't heard a chirp for fifteen minutes or a half hour. Seems strange—huh?"

He quickly brushed the raised 'phone back into position, and whirled the tuning knobs. "There's somebody going faint," he said over his shoulder, "It's none of our crowd, 'though, for he's coarse and low. Some kid with a spark coil, I guess.—Holy mackerel! He's calling me. Better not answer, I guess, or he'll talk all night."

The watching conductor saw the expression on his face change, saw the snatched pencil, and watched with interest the flying fingers. Then in consternation he saw the terribly white face that turned toward him. Unable to speak, the operator was holding out the yellow paper toward him, making meaningless motions with his mouth.

Startled, the conductor snatched the sheet. Quickly he read the scrawl. Then long years of railroading spoke. With lightning speed his hand leaped to the bell cord over his head and he pulled down steadily three times. There was a strained second, and then from the cab ahead came the long wailing shriek for brakes.

The tired business man woke with a sense of impending disaster, rudely jolted from his slumber as the monster ahead reeled on reversing wheels. The detective was flung unceremoniously on top of the two Italian laborers as the conductor applied the emergency air. And before the pretty young woman could voice her indignation to the startled salesman, the express was moving with ever-increasing momentum back over the rails she had just spurned.

And less than a half mile ahead the President's Special plunged thru the blinding snow, an almost breathless and thoroly blinded engineer clinging desperately to his throttle, praying, praying, praying that his luck would not desert him as the block signals had.

And in the operator's car a white operator was listening to the now audible spark of Mountain City as he informed Danville of the wrecking train and relief expedition dispatched in the wake of the President's Special.

And fifteen minutes later the sweat-streaked dispatcher at Danville heard the faint piping of the train station. Dumfounded, he pounded out a frenzied H. P. And then with pitiful incredulity stamped on his face he copied the almost inaudible Continental.

"On siding at Nestor," the straining ears fairly hugged the 'phones, "President's Special by. Where were you? Some amateur got me just in time."

And in the little farm-house a sobbing boy thanked God that his little half K. W. had broken thru.

Dick Baker's chair crashed from under his writhing form, and he rolled sobbing over the floor. Vainly he tried to shriek, but only low moans came from his parched lips. Then he lay still.

(*Continued on page 42*)

AMPLIFY YOUR RADIO SIGNALS

With the new DETECTAGRAPH-TRANSMITTER, the amateur can amplify radio signals to such an intensity that he can hear the signals about his station without the need of the telephone head set.

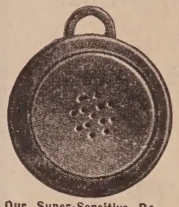
By the addition of a loud talking telephone he is able to hear the messages many feet away from the instrument.

The super-sensitive DETECTAGRAPH-TRANSMITTER herewith shown is two and three-eighths inches in diameter, five-eighths of an inch thick and weighs less than three ounces. It is the most sensitive sound detecting device ever brought before the public.

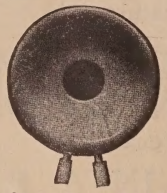
The manner in which the amplifying process is attained is by attaching with tape the DETECTAGRAPH-TRANSMITTER to the regular wireless receiver.

Not only is this instrument applicable for amplifying radio signals, but it can be used with equal satisfaction for magnifying other sounds. Phonograph music can be transmitted from one place to another by means of this instrument, and those who are afflicted with deafness will find enormous benefit by using this transmitter. It is the greatest device for building your own loud talking telephone, detectagraph and other devices. Can be used for any purpose where a sensitive detecting instrument is required.

SUPER-SENSITIVE Detectagraph MICROPHONE DEVICES



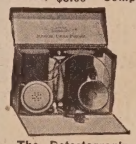
Our Super-Sensitive Detectagraph Transmitter. Price, $8.00 Complete



Our Special No. 25 Loud Talking Receiver. Price, $4.50 Complete

Detectagraph Rheostat, especially made for amplifying circuits. Price, $2.00 Complete

Super-Sensitive No. 40 Receivers to be used in connection with Detectagraph-Transmitters, $10.50



The Detectagraph Junior Deaf-Phone $18.00

Equal to any $35 instrument made. Outfit consists of Super-Sensitive Transmitter with cord connector; Super-Sensitive Ear Piece with small black cord; Black Single Headband; Black Case and Two Batteries.

Adjusted Model "B" Horn, with No. 20 High Grade Loud Talking Receiver, Cord Plugs and Desk Stand Base. Price, $12.00 Complete

Adjusted Model "C" Horn, with No. 20 High Grade Loud Talking Wall Receiver, Cord Plugs and Wall Base. Price, $12.00 Complete

Detectagraph $18.00 This detecting instrument of marvelous sensitivity can be used for detecting secret conversations. Outfit consists of Sensitive Transmitter, 25-ft. Black Cord, Receiver, Headband, Case and Battery.

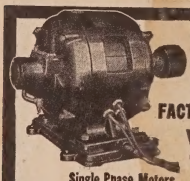
Order direct from ad.

Or write for free descriptive circular.

G. BOISSONNAULT COMPANY

25 CHURCH STREET NEW YORK CITY

Makers of Super-Sensitive Microphone Devices

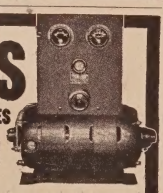


NEW MOTORS

FACTORY GUARANTEED - ALL SIZES - IN ORIGINAL BOXES

Your Opportunity

To Buy New Guaranteed Electrical Apparatus of Standard Manufacture.



Single Phase Motors

110-220 volts, A. C., 60 cycle 1800 R. P. M. with pulley

1/4	H. P., 110 volts, induction, full load start	$28.50
1/2	H. P., 110-220 volts, induction, full load start	$38.50
1/2	H. P., 110-220 volts, repulsion, for compressor	$52.50
1	H. P., 110-220 volts, repulsion, with sliding base	$76.50
2	H. P., 110-220 volts, repulsion, sliding base	$116.50
3	H. P., 110-220 volts, repulsion, sliding base	$142.50
5	H. P., 110-220 volts, repulsion, sliding base	$184.50

Charging Generators

Suitable for all lighting, Battery Charging and Power Requirements.

6 volts, 10 amp.	$19.50
15 volts, 10 amp.	$24.50
40 volts, 6 amp.	$31.50
110 v. 2½ amp.	$31.50
110 volts, 5 amp.	$46.50
40 volts, 30 amp.	$78.50
110 volts, 18 amp.	$106.50
110 volts, 25 amp.	$146.50
Moving Picture Arc Generator 60 v., 35 a.	$106.50

Polyphase Motors

2 and 3 phase, A. C., 220 v. 60 c., 1750 R.P.M., complete with base and pulley.

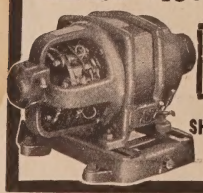
½ H. P.	$46.50
1 H. P.	$64.00
2 H. P.	$81.00
3 H. P.	$96.00
5 H. P.	$112.00
1 H. P., high speed, 3000 R.P.M., 220 v 2 phase only	$36.50

Battery Charging Outfits

To operate on A. C., 60 cycle, single phase. Voltage as specified.

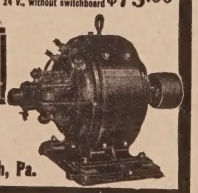
110-220 v., A.C., 150 watts, 15 v., with switchboard	$68.50
110-220 v., A.C., 150 watts, 30 v., with switchboard	$68.50
110-220 v., A.C., 175 watts, 24 volts, with switchboard	$68.50
110-220 v., A.C., 250 watts, 36 volts, with switchboard	$88.50
220 volts, 2 phase, 600 watts, 24 v., without switchboard	$75.00

WRITE FOR CATALOG. BARGAINS IN MOTORS AND GENERATORS



SPECIAL 1/4 H.P. 110 volts A.C., 60 c. S. P., 1750 R.P.M. Complete, cord, plug and pulley

WASHING MACHINE MOTORS Suitable for operating Small Compressors, Coffee Grinders, Bottle Washers, Etc. $22.75 Each Reg. Val. $32.50



MONEY BACK GUARANTEE

SHIPPING TERMS: 25% deposit required on all orders. Balance C. O. D. by Express. Sight draft with Bill of Lading attached by freight.

MANUFACTURERS' DISTRIBUTER

CHAS. H. JOHNSTON, Box 16, West End, Pittsburgh, Pa.

We Can Supply You With Materials for That Set You Are Building

Send for circular

PENN RADIO APPARATUS CO.

Greenville, Pa.

Tucker's Overall Waterproofing Insulator

Grade A replaces Shellac, Rubber and Tape on Tubes, Coils, Wires and Terminals. Used on Cotton Covered wire will carry high Voltage under water. Used on Terminals, prevents leaks, short circuits. Grade B. used in Cables and lead wires. Will stick to anything. Not affected by salt water, acid, oil. 90c pt., $1.50 qt., $5.00 gal. Tucker Waterproofing and Insulating Co., 664 Pleasant Street, Brockton, Mass.

DEFOREST

Here's a Receiver with Eight Distinct Advantages

A COMPLETE, compact and inexpensive Receiving Set having improvements and refinements which increase efficiency and eliminate many objectionable features of receiving apparatus.

No longer is it necessary for you to have two or three expensive, inconvenient and cumbersome tuners spread all over your operating table when working all wave lengths. With this new DeFOREST tuning system you can work any and all wave lengths with the one tuner shown at the right. This Set has distinct advantages of minimum table space and of convenience in coupling not equalled in any other type of apparatus. The entire Set is complete in the two cabinets shown here. The Genuine DeFOREST "Honey Comb" Coil System of Tuning is employed—no superior system has ever been invented.

This is a new DeFOREST production embodying a unique and superior tuning system. Possession of this Set means more efficient and satisfactory operation; more pleasure and practical benefit for every Amateur. Its price is remarkably reasonable for the quality of apparatus and the distinct advantages the Set offers. Find out more about it at once.

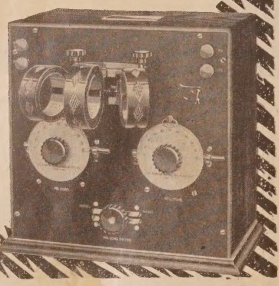
DeFOREST Agencies are located in all Principal Cities. Ask your regular Electrical Dealer to get you DeFOREST Apparatus.

These Eight Advantages are not duplicated in any Receiving Set at double the price:

1—Responds to any wave length 150 to 25,000 meters.
2—More flexible in coupling.
3—Lower distributed capacity; less high frequency resistance and decrement values.
4—Eliminates cumbersome switches, inefficient taps and losses from dead ends.
5—Vernier Air Condensers of unusual design.
6—Signals come in louder and clearer.
7—Superior in efficiency, workmanship, convenience and appearance.
8—Requires minimum table space; note sizes of cabinets.

Combination Audion-Ultra Audion and One-step Amplifier; Type P-300. Size 12½"x9⅜"x7⅜". Price $73.50. Vacuum Tubes, $7.00 each extra.

Tuner; Type T-200. Size 13⅜"x12½"x8". Price $77.50 without Coils.



Send for a DeFOREST Manual

a 56-page book containing full information about this and many more DeFOREST instruments, as well as giving much useful information for the Amateur. Mailed anywhere upon receipt of 10 cents.

DeFOREST RADIO TELEPHONE AND TELEGRAPH CO.

Inventors and Manufacturers of High Grade Radio Apparatus.

1401 Sedgwick Ave., New York City

LEE DeFOREST, INC., Western Distributors

451 Third Street, San Francisco, Cal.

(Shipments Direct From San Francisco Stock)

Quality—Efficiency—Economy

These are the three factors which combine to make all the equipment sold by us the best in the market today. A trial order will convince you. Our apparatus is service-tested. Look at the bargains below and then use your judgment.

COPPER AERIAL WIRE

50c per 100 Feet

Another large shipment of this excellent solid copper wire has just been received by us. The gauge is No. 14 and the wire runs 80 feet to the pound. We also sell No. 12 gauge at 80c per 100 feet. This size approximates 50 feet to the pound.

A FEW MORE BARGAINS

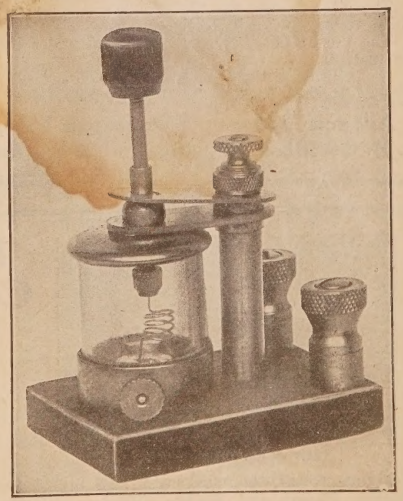
500 cycle test buzzer—shipping weight, 1 lb.	$0.80
75 ohm watchcase receivers—shipping weight, 1 lb.	1.00
Marconi VT Audion bulb—class 2—shipping weight 1 lb.	7.00
Panel type rheostat—shipping weight 1 lb.	1.00
4 prong VT sockets, aluminum—shipping weight 1 lb.	1.50
Telephone plug and jack—slightly used—shipping weight 4 ounces—complete	0.85

Cash in registered letter, check or money-order must accompany all orders. If shipment by parcel post is desired include postage, otherwise material will be shipped by express collect.

Our illustrated catalogue of 64 pages is now ready. 15c in stamps will secure a copy. This amount will be credited on your first order for $1.50 or over.

Electrical Specialty Company

Dept. R—48-50 So. Front St., Columbus, Ohio



Weather Proof Crystal Detector

The type of the detector illustrated is being sold at prices ranging as high as $4.50. Our price is $2.80. This instrument is absolutely dust and moisture proof. The crystal, which is one of galena mounted in a block of Woods metal, is encased within a glass cylinder rendering it impervious to atmospheric conditions. Has ball and socket joint. Shipping weight 1 lb. Price $2.80.

Stromberg-Carlson Radio Head Sets

Equipped with Non-conducting spool heads and slotted pole tips which eliminate eddy current losses.

All operating parts of the Stromberg-Carlson Radio Head sets are housed in dust-proof and moisture proof aluminum cases. Diaphragm is mounted metal-to-metal. Temperature variation will not disturb the airgap adjustments. Each set is wound to a resistance of 2,000 ohms with pure copper wire and furnished complete with 6-foot moisture-proof cord attached. This set, while it is constructed strong and durable, is very sensitive. For use ashore or aboard ship.

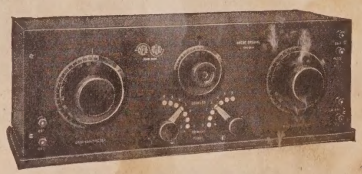
A sample set will be sent upon receipt of $12. Try it in your own station for private and commercial Radio Service. Money refunded if not satisfied.

Bulletin 1606 Gives Full Particulars. Write

STROMBERG-CARLSON TELEPHONE MFG. CO.
Rochester, N. Y., U. S. A.

No Seals—No Secrets—*BUT SERVICE!*

There is only one Relay Receiver, the



GREBE RADIO

Type CR-3
Relay Receiver

Inspection of the interior of this Receiver reveals design and workmanship fully in keeping with its outward appearance.

The circuits used are thoroughly explained in the instructions and blue prints which accompany each Receiver.

The use of this Receiver is licensed under the original Armstrong and Marconi patents.

The GREBE RADIO guarantee is absolute and unconditional. Each instrument manufactured by us must give satisfactory service. Our interest in the purchaser does not terminate with the sale.

Ask your dealer to show you our line of super-grade apparatus

A. H. GREBE & CO., Inc. 72 Van Wyck Blvd., Richmond Hill, N. Y.

VIEW IN RADIO LABORATORY

Become a Commercial Operator on the Pacific Coast

Positions constantly open on vessels plying to South America, the Orient, Alaska, Hawaii and Atlantic Coast. Salaries, $125 and expenses. Best equipped Radio School on Pacific Coast. For further information address

Y. M. C. A. School of Radio Telegraphy

Seattle, Washington

(*Continued from page* 40)

A moment later he struggled to a sitting posture and gazed sheepishly about him. The familiar table met his gaze, the Audion glowing unwinkingly, the brass switch points glaring disapprovingly down at him.

Then came realization. He struggled to his feet, and switched off the A. and B. batteries.

Then he scowled at the set. "That's the last time I try to sit that gang out," he muttered, as he threw the lightning switch, "If I never do any long distance work I hit the hay at twelve in the future. My God! Some nightmare!"

Club Gossip

(*Continued from page* 25)

Herbert Kelsey and Arthur Heron. They did their part and did it well.

Correspondence should be addrest to Miss Sonia Soberg, Bushwick Evening Trade School, 400 Irving Avenue, Brooklyn, N. Y.

Radio Research Club.

The Radio Research Club has recently been organized in order to form a close co-operation and mutual understanding among radio amateurs of the vicinty so as to realize for the members those peculiar advantages associated with such an enterprise. This club has undertaken advanced radio research work and associated subjects. The members are all real radio enthusiasts and have their own outfits. At present the club is up to its full quota of members. The meetings are held every Friday evening at 789 E. 163d Street, New York City, at 8:00 P. M. All amateurs of the vicinity are cordially invited to attend the meetings.

The officers are: Nat Sauberman, president; G. Eleckrig, vice-president; S. Ellner, treasurer; Jonas Cohen, secretary. All communications to be addrest to the secretary, Jonas Cohen, 789 E. 163d Street, Bronx, New York City.

National Association of Radio Electricians.

A movement has been launched to organize a national association of all radio electricians for the purpose of bringing together these highly skilled and specialized radio men that the science may be represented by the element which actually takes an important part to make radio profitable and successful. Engineers and research workers, etc., are well represented and it is proper and fitting that the mechanics of the art club together in a little party all their own.

The purpose of organization is to foster the general welfare, promote a spirit of fraternity and extend every measure of benevolence and aid to members who may travel over the great sections of water front of the country. That they may enjoy life insurance benefits, sick benefits, and in short give the members privileges and assistance such as exist in many of our national orders. When the movement is sufficiently advertised, an application for a charter will be made.

Most of the old timers, those old United, Marconi, International, De Forest, Tropical, National Electric Signal men, will certainly welcome this movement.

I feel this plan will meet with your approval for you can comb your experience and get back to the old days of 1899 and compare the game as it is now. Address Mr. Joel J. Michaels, General Delivery, Post Office, New York.

South Jersey Radio Association.

The regular monthly meetings of the South Jersey Radio Association will be held as usual on the third Thursday of the month at the Fire House, Collingswood, N. J.

Our members shone at the big banquet in Philadelphia on the eighth. But they also shine in working their sets and do not disobey the law. Mr. Cadmus, our inspector, was disappointed in his recent trip to New Jersey. He hoped to *get* someone. We have some fine stations in this club and they are handling the relay traffic very well indeed. We have dances to the wireless telephone from 2 X J, Deal Beach, N. J. We are very much alive and are growing all the time. We invite all amateurs in this vicinity to join our association. —The Secretary.

The College Hill (Easton, Pa.) Radio Club.

On April 12, 1920, the College Hill Radio Club was formed for the purpose of studying radio telegraphy and electricity. The club has now a membership of six, but it is going to take in new members very soon.

The club meets at the houses of the different members on Wednesday night of every week. Most of the members have a wireless set. At every meeting there are lectures given by one of the members on radio telegraphy or electricity.

As yet the club has not a transmitting set but one is to be installed in the near future.

(*Continued on page* 44)

CONNECT "A A" to your detector or amplifier, and "B B" to a 6-volt battery

MAGNAVOX

RADIO TELEMEGAFONE

Type R-1 with small horn $75
Type R-2 with large horn $93

DEALERS

Atlantic Radio Co., Boston, Mass.
Doubleday-Hill Electric Co., Pittsburg, Pa.
Pacent Electric Co., New York, N. Y.
Intermountain Electric Co., Salt Lake City, Utah.
Southern Electrical Co., San Diego, Calif.
Magnavox Representative, 606 Mutual Life Bldg., Seattle.

Ask for Bulletin 21020

THE MAGNAVOX COMPANY

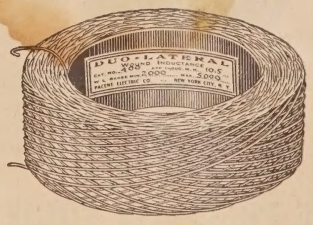
2701-2765 EAST 14TH STREET
OAKLAND, CALIFORNIA

SOMETHING NEW!

DUO-LATERAL WOUND COILS

THE DUO-LATERAL COILS now being offered for the first time is not to be confused with any other type of machine wound inductances which have been on the market for some time.

The Duo-Lateral Coil made in various sizes for general and specific application has the following distinct advantages which make it superior to any other coil for amateur and commercial work alike.



1. *Lower natural period.*
2. *Lower high frequency resistance.*
3. *Very low distributed capacity.*
4. *Lower direct current resistance.*
5. *Higher self-inductance.*
6. *Mechanically stronger.*

Bulletin P1R, containing valuable engineering data, constants and prices of numerous sizes of Duo-Lateral Coils covering practically every wavelength used, is yours for the asking.

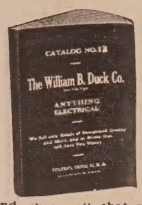
MANUFACTURERS, DEALERS, JOBBERS and DISTRIBUTORS—write for our proposition.

SALES AGENTS for Electrical Products Mfg. Co., A. H. Grebe & Co., Dubilier Condenser Co., Richter and Byrne, Rawson Electrical Instrument Co., The Magnavox Company and others.

PACENT ELECTRIC COMPANY, Inc.

Builders and Specialists in Radio, Electrical and Laboratory Equipment.

150 NASSAU STREET Telephone: Beekman 5810 **NEW YORK CITY**



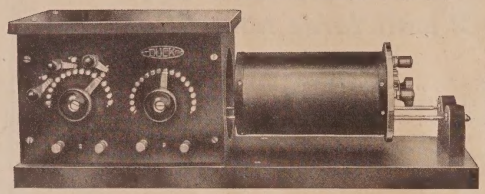
DUCK'S New Big 200-Page No. 14 Wireless Catalog and 100 Page Electrical Catalog

The wireless catalog mailed for 12c and the electrical catalog for 6c, either in stamps or coin, which amount you are privileged to deduct on your first order of $1.00. Catalog positively not sent otherwise.

This edition of our wireless catalog is the most complete and elaborate we have ever put out. It embraces everything in wireless worth while. As an encyclopedia of information it is invaluable. It is printed on excellent paper and with a beautiful cover. Your amateur friend will tell you that there never has been any wireless catalog to take the place of Duck's, and above all that you can absolutely rely on the quality of every instrument listed in this catalog. In a word it is all worth while catalogs in one.

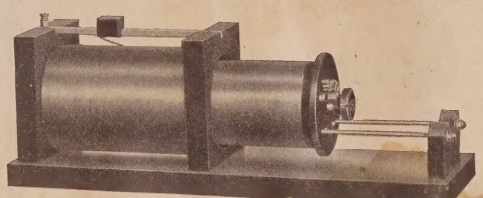
Audio Tron bulbs prepaid $6.00

We discontinued selling Audio Tron bulbs and accessories for a short time but we have again resumed their sale and can guarantee immediate delivery.



NEW MODEL 5BB. NAVY TYPE RECEIVING TRANSFORMER

A big improvement over our former model. Primary divided into four sections, with three dead end switches, greatly improving selectivity. Secondary divided into three sections, with two dead end switches, eliminating harmonics. The change in the construction of the guide rod support makes it possible to obtain a looser coupling. It is a wonderful improvement over our old model both in performance and appearance. Only $27.50.



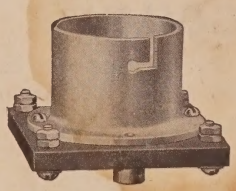
OUR IMPROVED ARLINGTON RECEIVING TRANSFORMER

The secondary on our new type Arlington is divided into three sections with two dead end switches, eliminating dead end effect and harmonics and giving greater selectivity. The end support is similar to that on our Navy type permitting a looser coupling. It is a beautifully finished instrument.

Price Only $15.00

THE WILLIAM B. DUCK CO., 231-233 Superior St., Toledo, Ohio

O, WHAT A PAL



was Mary, but say boy, do you know an up-to-the-minute radio installation is SOME pal too?

We manufacture high grade apparatus only.

Here is a good value—The Ace V.T. Socket—with grid leak at $1.50 each. Better buy Ace equipment than be sorry you did not. Ask your dealer.

THE PRECISION EQUIPMENT COMPANY

2437 GILBERT AVENUE (Dept. A) CINCINNATI, OHIO

WIRELESS AMATEUR

Send a 2c stamp for full description of the most efficient detector in the wireless field today.

Tested by Marconi Wireless Telegraph Co. and U. S. Government. Instantly adjustable at a constant pressure.

L. STEWART BARR, Inventor, Vice-President of The Service Radio School

THE BARR MERCURY-CUP DETECTOR Dept. B, The Wyoming, Washington, D. C.

(*Continued from page 42*)

The club subscribes to the important wireless and electrical magazines for the benefit of the members.

At the last meeting the following officers were elected: President, Clarence H. Tupper; secretary and treasurer, John G. Knight. The club will be glad to hear from anyone interested. Address all communications to the secretary, John G. Knight, Sullivans Lane, Easton, Pa.

The Junior Radio Club of Philadelphia.

The Junior Radio Club of Philadelphia, Pa., is composed of some of West Philadelphia's wide-awake amateurs. Altho not very well known at present, it is progressing rapidly, several of the members already having radiophones designed and built by themselves. These may be heard within a radius of eight miles with an ordinary receiving set. Every member of the club anticipates getting a radio telephone for communication among the members of the club and for experimental purposes.

At present we have no clubroom, the meetings being held at members' homes.

At every meeting code-practise plays a prominent part. Any new member, within a period of two months, has to pass a test consisting of simple hook-ups, rules and regulations and to be able to send and receive four words a minute. The second class test consists of more complicated diagrams, rules and regulations and code work at a speed of eight words a minute. The first class examination consists of theories, atmospheric conditions and twelve words a minute for code work. Members are then eligible for amateur license examination.

The club has a library which includes most good radio books and magazines, for which we set aside a definite part of the dues. Communications or inquiries may be address to Nicolas Henwood, assistant secretary, Junior Radio Club, 717 South 63rd Street, Philadelphia, Pa.

The Experimental Science and Radio Club of Calais, Me.

Last October several of our leading radio amateurs joined forces and organized a radio club called "The Radio Amateurs of Calais."

But soon it was found that a club not well organized cannot run long, for that association only held two meetings. At any rate, it ran long enough to show the amateurs of this city that what they needed was a club with a good solid foundation supported by all. With this idea in view the Experimental Science and Radio Club was started and was loyally supported by all. At the first meeting a constitution was drawn up, a system was adopted by which we run all our meetings, and the proper officials were elected.

We are sorry to say that our club station is not as yet able to be termed a long-distance station, but a larger set will soon be installed.

In one of our weekly debates there arose the topic: "Who is the greater inventor, Edison or Tesla?" After several stiff debates whereby one side said that Edison's inventions were of more use to the common people, while the other side claimed that the people have not yet realized what Tesla has done for them in his inventions, such as the induction motor and three-phase transmission. This topic was laid aside, as neither side was willing to give in, until a later date so that the club members can read up on these two great inventors.

This club holds meetings every Friday night under the following officers: W. Robert Dresser, president; Harold V. Jewett, secretary; and the other necessary officers, with M. L. MacAdam as club station operator. The E. S. & R. Club, 283 Main Street, Calais, Me.

The Westtown Radio Club.

The Westtown Radio Club is located at the Westtown Boarding School, Westtown, Penna. It is made up of students of the school and associate members, who are interested in the development of radio communication.

The club was reorganized in the late fall of 1919. Before the war a club had been formed of a few students who were especially interested in the art. But it was disbanded when the United States entered the war. There were about six survivors of the old club in late 1919. The number rapidly increased to forty-four.

The club meets every Thursday evening in one of the classrooms of the school. The members are divided into two classes: Full members and student members. Full members are those who have passed an examination given by a group known as the board of directors. The examination includes a few questions and a test in code work. The member must be able to receive at the rate of five words per minute.

At present the club owns a receiving set, but a larger and more complete set is being planned to be hooked up in the fall term of school.

We will be very glad to correspond with all who are interested. Osman J. Seeds, secretary, Westtown Radio Club, Westtown Boarding School, Westtown, Penna.

Madison Radio Club.

Madison Radio Club was organized March 1, 1920, by the High School Wireless Class members under the direction of J. A. Riner, Ex-Signal Corps officer.

At the first meeting sixteen members were taken in and the club now has thirty-seven members, each and every one owning and operating a radio station.

Radiogram blanks and membership cards of the club show the live interest in the radio art by the members who display the greatest enthusiasm.

Bellingham, Wash

Wireless telephone and high-frequency programs have been put across successfully by the club members, and a program of some sort is given every meeting.

The club sends and receives messages for the business men of the city and has gained quite a little renown thru the papers.

Daily press and weather reports are posted by the club

The set at the High School, where we are privileged to hold our meetings, is capable of "radiophoning" 75 to 100 miles, while the radio telegraph scope is 500 miles, altho we have reached 700 miles. All the European stations are heard. Address Secretary of Radio Club, Madison High School, Madison, Wisconsin.

The Oshkosh Normal School Radio Club.

On April 27th about fifteen radio enthusiasts, some of whom are ex-service men, met at the Oshkosh Normal School to organize a radio club, the purpose of which is to perfect radio communication in the city. The following officers were elected: President, John N. Becker; vice-president, Paul Simonds; secertary-treasurer, Vernon D. Wood.

Daily communication is to be carried on among the various local stations and with other cities thruout the state. Test messages are to be sent out frequently by the Normal School station in order to determine the receiving ability of the smaller stations.

Meetings are to be held on the first Tuesday of every month at 7:30 o'clock at the Normal School physics laboratory.

The secretary, Mr. Vernon D. Wood, 15 Algoma Street, Oshkosh, Wis., would be pleased to hear from any of the other radio clubs in the United States.

Summit, N. J., Y. M. C. A. Radio Club.

The Y. M. C. A. Wireless Club will install a complete working plant with operators in charge both afternoon and evening. C. P. Dean, assistant boys' work director of the Y. M. C. A. at Summit, N. J., will be in charge of the exhibit and will be on hand to explain latest development in the wireless art.

Batavia Radio Club.

Batavia, N. Y., is to have some new wireless apparatus. The Batavia Radio Club is composed of a group of sixteen members who have placed an apparatus on the Y. M. C A. building which will be able to receive wireless messages within a radius of 1,200 miles. A sending set will also be added to the equipment.

Officers of the clubs are: President, Norman S. Odell; vice-president, George Boughton; secretary, Archie King; treasurer, Cecil Odell. The club holds meetings at the Y. M. C. A. and a lecture on electricity is given at each meeting by some of the members, and occasionally an out-of-town speaker will be obtained.

Rochester, N. Y., Radio Club.

The Rochester Radio Club, at its fortnightly meeting, recently elected the following officers: President, Ralph Haire; vice-president, Maurice Nelson; secretary, George Patterson; assistant secretary, Russell Deane.

The following committees were appointed: Engineering, Donald Wood, Arthur Haven, Ward Atkinson; publicity, Leonard Corly, Victor Martin, assistant chairman.

During the meeting prizes were awarded to members who obtained the best results in the relay contest which was held some time ago. The first prize, a vacuum tube, was awarded to Maurice Nelson, and the second prize, a two-year subscription to a radio magazine, was awarded to Ellwood Sneider.

The club is open to anyone interested in wireless telegraphy.

Houston, Tex., Radio Club.

To encourage the study of radio by amateurs, the Houston Radio Club will transmit late news flashes furnished by *The Chronicle* every night at 7. The news will be sent out over a radius of 500 miles and the week's baseball scores will be included in the news flashes.

Almost any person can afford to install one of the little receiving sets capable of taking the messages sent out by the Radio Club. The sets are inexpensive and no license is required for their installation.

It is stated by the Houston Radio Club that there are seventy-five sets already installed in Houston, some of them powerful enough to send to and receive from Chicago. In fact, Houston boys often communicate with friends at great distances.

Weather reports are given out every night at seven o'clock, and news of national and international interest will soon be flasht out at the same hour.

The Houston Radio Club was organized for the purpose of increasing interest in wireless telegraphy and will answer any questions or communications regarding wireless addrest to it or sent thru *The Chronicle*, Houston, Texas.

Albany, N. Y., Radio Club.

Various experiments were conducted recently by members of the Albany Radio Club at the regular weekly meeting at the Central Y. M. C. A. Wireless communication was establisht with several sta-

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"Navy" Set—3200 ohms, $14.

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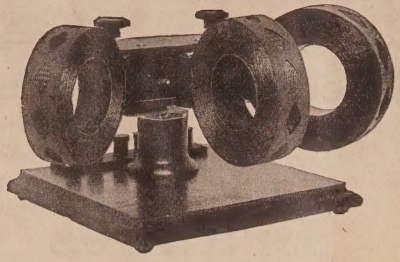

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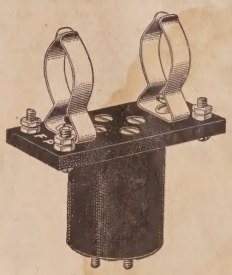

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$3.00 Graphite Potentiometers	$2.85
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tions thruout this section, altho no messages were sent out by the members.

Plans are being made for the installation of a sending outfit, and it is expected the equipment will be set up by next fall. When these plans materialize the club will possess one of the best-equipt receiving and sending stations in this section.

A lecture by wireless is being planned and the sending equipment of a local electrical company will be used in the experiment. Apparatus will be rigged up to amplify the receiving of the lecture and members will listen to the human voice being sent thru the air.

A membership drive is being considered, which is hoped will bring every amateur radio operator in Albany into the club.

Nassau Radio League.

Fifteen wireless men attended the reorganization meeting of the Nassau Radio League recently at Freeport, L. I. The following officers were elected: President, Thomas F. O'Brien; vice-president, Lester Hardy; secretary-treasurer, Edward O'Brien; chief operator, Robert Johnston. Sinclair Raynor, Donald Wallace and Sealey Southard, with the above officers, were elected as the board of directors.

Philadelphia Amateur Radio Association.

The first annual convention of the Philadelphia Amateur Radio Association opened with a banquet recently in Mosebach's Casino on Girard Avenue.

Lieutenant Commander Cobb, district communication superintendent of the Fourth Naval District, stated that investigation proved that amateurs have not deliberately attempted to interfere with the naval messages, and the trouble has been practically eliminated. The organization, he said, will be a great asset to the welfare of the nation, both in times of peace and emergency, as displayed in the last few years. He offered information and help in the radio line to anyone who would call at the radio office at the Navy Yard.

Other speakers included J. O. Smith, W. E. Downey, Charles H. Stewart and Hiram P. Maxim.

The election of officers resulted as follows: Dr. Gordon M. Christine, president; Malcolm Ferris, vice-president; H. Paul Holz, secretary. Regular sessions are held at No. 1611 Columbia Avenue, Philadelphia, Pa.

Leipsic, Ohio, High School Radio Club.

The High School at Leipsic, Ohio, has installed a radio station which is now in operation and messages are received by the radio club every day. The first word plucked out of space by the wireless enthusiasts was "twenty". Weather reports and baseball scores are copied every night. H. Johnson, graduate of the government radio school, Harvard, is instructor.

The New Jersey Radio Club.

The New Jersey Radio Club was formed at a meeting held in the New Jersey School of Radio-Telegraphy, Elizabeth, recently. There were present about thirty radio students, from this section of the State, who attend the evening class at the radio school. It is expected that about ten students of the day class will also join the club. A. V. Hill, of Elizabeth, was elected president, and C. J. Frank, also of Elizabeth, secretary and treasurer.

Meetings will be held every Thursday evening at the school, 218 Broad Street, Elizabeth, which is the club's headquarters. A ½-K. W. Marconi transmitting set with a radius of 350 miles, also a receiving set with a radius of 3,000 miles, has just been installed in the school.

In the near future a trip to the Fleet Supply Base and Bush Terminal, Brooklyn, will be made under the supervision of Lieut. H. Armerding, U.S.N.R.F., who is the principal at the radio school. Other trips of this sort are in prospect for the members of the club.

The Radio Engineering Society of Pittsburgh.

An important meeting of the Radio Engineering Society of Pittsburgh was held recently in the meeting room of the American Legion, fifth floor of the old Public Safety Building, Sixth Avenue. The meeting was open to radio experimenters and others contemplating taking up the wireless study. An informal explanation of the wonderful new electrical instrument which radiates music by wireless was given by Dr. P. Thomas, of the radio research division of the Westinghouse Electric and Manufacturing Company.

The Wireless Society of London.

At a meeting of the Wireless Society of London held in the Lecture Hall of the Institution of Civil Engineers on April 30th, a paper was given on an Automatic Call Device by Major Basil Binyon, O. B. E. By means of an aerial which had been erected Major Binyon was able to give a practical working demonstration of this ingenious piece of mechanism.

Pre-arranged messages were received from Wireless Station at Slough and the selector mechanism proved beyond doubt, that it would respond only to signals for which it was set to receive. By the use of this apparatus it is therefore possible to make use of only one operator on board ship so that during the less busy hours of the day the Automatic Call Device may be left to take incoming signals and on the receipt of a message giving the call sign of the ship in which it is installed, or the distress signal S. O. S., a relay is put in action, a bell rung, and the operator

called to his instrument. Those present voted this one of the most interesting meetings the Society has yet held and Major Binyon was accorded a hearty vote of thanks.—H. LESLIE MCMICHAEL, *Secretary.*

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District Communication Superintendent,
Third Naval District,
44 Whitehall Street,
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To All Amateurs:

A copy of the Amateur Radio Code, used in connection with the Amateur Radio Broadcast transmitted by the New York Naval Radio Station, will be forwarded to you upon receipt of this form properly filled out:

1. Name.
2. Address.
3. Age.
4. Any military service performed.
5. Any commercial experience.
6. Grade of radio license, if any.
7. Number of words you can receive per minute.
8. Education.
9. Size and power of transmitting set.
10. Type of undampt wave receiver.
11. Name of any radio organization or club to which you belong.

Very truly yours,
R. B. COFFMAN,
Lieutenant Commander, U. S. N.

The Boy Scouts of America are handling these information sheets for the Navy as a matter of public service. Please fill out and mail to Armstrong Perry, Seascout Radio Commodore, Boy Scouts of America, 200 Fifth Avenue, New York City.

GET THE NAVY AMATEUR RADIO CODES.

By filling out the above information blank and sending it to the address given on it, any radio amateur may obtain a copy of the Navy Amateur Radio Codes.

These can be used in deciding code messages broadcasted from Naval Radio stations daily.

Amateurs can secure valuable practice by receiving and decoding these broadcasts. They are transmitted at slow speed, ten words per minute, which is ideal for the beginner.

The Boy Scouts of America are handling these information blanks for the Navy as a matter of public service.

This notice is printed free of charge by RADIO AMATEUR NEWS and its co-operation is hereby gratefully acknowledged.

Any radio amateur who is willing to offer his services and his station to a troop of scouts or the local council of the Boy Scouts of America in his city for the receipt of official messages is assured of a cordial welcome. Report to the nearest scout headquarters.

The assistance of radio organizations also will be appreciated. Lecturers, teachers and leaders are needed to make the amateur system effective.

(Signed) ARMSTRONG PERRY,
Seascout Radio Commodore, Boy Scouts of America.

AMPLIFIER HINT.

The "plug and jack" method of changing from one step to another in multi-stage amplifiers is very common. However, the mistake of connecting the plug directly to the phone cords is often made. Instead of doing this, connect it to a short length of double flexible cord. Bring the end thru a hole in the panel and connect to a pair of binding posts on the side of the panel. A loud speaker, or as many pairs of phones as desired, can now be connected. This was hardly possible before.

Contributed by
ROBERT HERTZBERG.

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The EASIEST, QUICKEST, CHEAPEST WAY
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In Half the Usual Time

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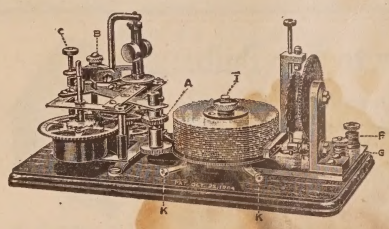
"Just Listen—The Omnigraph will do the teaching"

The Omnigraph is an *Automatic* Transmitter that teaches you both the Wireless and Morse Codes, at home, without any expense except the cost of the machine itself. Merely connect to battery and your Buzzer, or Buzzer and Head Phones, and the Omnigraph will send unlimited messages by the hour, *at any speed* you desire.



USED BY THE U. S. GOVERNMENT

The Omnigraph is used by the Government in testing all applicants applying for a Radio License. It is also used extensively by the large Universities, Colleges and Telegraph Schools throughout the Country for teaching Wireless and Morse. Hundreds of the Army's skilled operators who served during the war learned with the Omnigraph.

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Write for Free Catalog

Send for a catalog to-day, showing the 3 different models, $12.00 to $28.00. Every Omnigraph is sold with the absolute guarantee that you must be satisfied or your money back for the asking. Mail the coupon to-day—the catalog will come to you by return mail.

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Gentlemen:—
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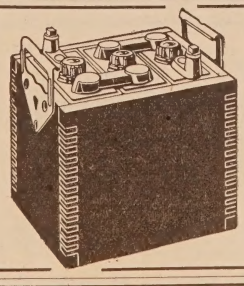

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Plates 5⅝" Wide
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These storage batteries are Canadian Made, from Canadian material by Canadian labour.

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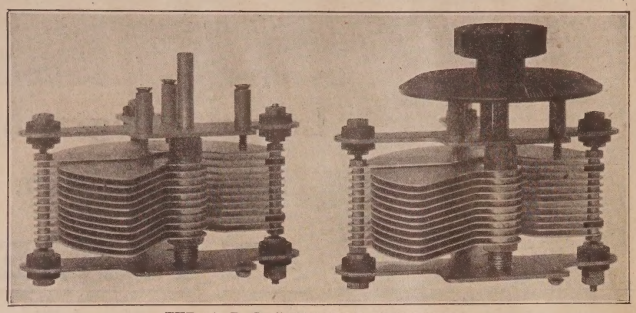
The "A. R. CO." Variable Condenser



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illustrated above, is made in two capacities—.0005 Mfd. and .001 Mfd. The rotary plates are rounded on one end, affording a straight-line capacity—a valuable feature in wave meter work. The condenser is furnished unmounted only but with the addition of Dial and Knob, if desired. Dial is of moulded composition, scale in white—0-100 reading. Bakelite Knob. We can guarantee this condenser in every way as to quality, reliability and satisfaction. The low price is decidedly an innovation.

PRICES:

Capacity	Unmounted	With Dial and Knob
.0005 Mfd.	$5.00	$6.00
.001 Mfd.	6.25	7.25

"BULLETIN 14"—describing and illustrating the best in RADIO EQUIPMENT will be mailed upon receipt of 10 cents in stamps—this amount may be deducted on your first order of $1.00 or over.

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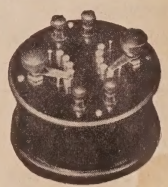
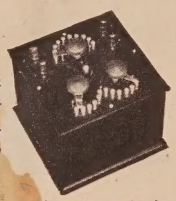


Hook'er to Yer Bulb.



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"GREAT" says one old sea dog. "WHAT IN SAM HILL WILL YOU SMART ALECS GET UP NEXT?" European stations copied in day time and no fancy aerial is needed. A single wire about 40 long by 25 high will do the trick. London amateur W. R. Wade, Clifton, Bristol, promises report for the magazines to publish showing how the amateurs there receive our sigs in England. Junk your funny wound coils and get a regular two pound tuner that you can use during the static season. 20000 meters maximum wave length. Hook up on bottom of tuner.

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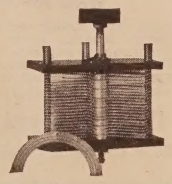
11 plate knocked down	$1.80
21 plate knocked down	2.25
41 plate knocked down	3.20
11 plate assembled	2.75
21 plate assembled	3.25
41 plate assembled	4.25



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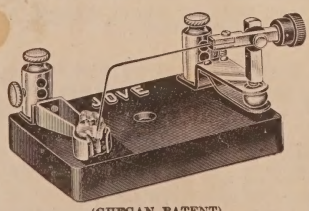

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The United States Civil Service Commission announces open competitive examinations for the positions listed above. Vacancies in the Air Service at Large at the salaries indicated, and in positions requiring similar qualifications, at these or higher or lower salaries, will be filled from these examinations, unless it is found in the interest of the service to fill any vacancy by reinstatement, transfer, or promotion.

The entrance salary for either position, within the range stated, will depend upon the qualifications of the appointee as shown in the examination.

All citizens of the United States who meet the requirements, both men and women, may enter these examinations; appointing officers, however, have the legal right to specify the sex desired in requesting certification of eligibles.

The duties of appointees will be as follows:

(*a*) To conduct or superintend the investigation of radio phenomena on the ground and in different types of aircraft (including single-seater airplanes) in flight; development, design and construction or practical and special radio apparatus for use on or in connection with aircraft; and development of methods of installation of radio apparatus on aircraft and the incorporation of said apparatus in the structure of the aircraft itself.

(*b*) To devise and institute standard systems of inspection and test for determination of serviceability of apparatus, or repair of unserviceable apparatus and of installation on airplanes under manufacture or undergoing repair or overhauling.

Competitors will not be required to report for examination at any place, but will be rated on the following subjects, which will have the relative weights indicated:

Subjects.	*Weights.*
1. Physical ability	10
2. Education, experience, and fitness	90
Total	100

Competitors will be rated upon the sworn statements in their applications and upon corroborative evidence.

For the position of radio engineer, applicants must have graduated with a B. S. degree, with major courses in physics or electrical engineering, from a college or university of recognized standing; and, in addition, have had at least three years' experience in the design, manufacture, or installation of radio apparatus for the Government or for a contractor who has supplied satisfactory apparatus of this class to the Government.

For the position of assistant radio engineer, applicants must have had the education and one year of the experience prescribed for radio engineer.

For either position two years of acceptable research work in radio or radio engineering or electrical engineering, dealing with high-tension current transmission, will be accepted in lieu of each year lacking of the college or university course, except that at least one-half of the experience offered must have been in radio work. Applicants must also possess a knowledge of airplane radio telephone apparatus and methods of installation on aircraft, must me qualified to pilot airplanes of the single-seater pursuit type, and to make adjustments, tests, and investigation of radio apparatus and phenomena while flying.

Applicants should submit with their applications evidence of training and experience in aeronautical engineering and in piloting airplanes.

Applicants will be admitted to these examinations regardless of their age, but at the request of a department making appointment certification will be made of eligibles who are within reasonable age limits, except in the case of persons entitled to preference because of military or naval service, to whom age limits do not apply.

Applicants must submit with their applications their unmounted photographs, taken within two years, with their names written thereon. Proofs or group photographs will not be accepted. Photographs will not be returned to applicants.

Applicants will be admitted to these examinations regardless of their residence and domicile; but only those who have been actually domiciled in the State or Territory in which they reside for at least one year previous to the examination, and who have the country officer's certificate in the application form executed, may become eligible for permanent appointment to the apportioned service in Washington, D. C.

Applicants should at once apply for Form 1312, stating the title of the examination desired, to the Civil Service Commission, Washington, D. C.; the Secretary of the United States Civil Service Board, Customhouse, Boston, Mass., New York, N. Y., New Orleans, La., Honolulu, Hawaii; Post Office, Philadelphia, Pa., Atlanta, Ga., Cincinnati, Ohio, Chicago, Ill., St. Paul, Minn., Seattle, Wash., San Francisco, Calif.; Old Customhouse, St. Louis, Mo.; Administration Building, Balboa Heights, Canal Zone; or to the Chairman of the Porto Rican Civil Service Commission, San Juan, P. R.

Applications should be properly executed, excluding the medical certificate, and filed with the Civil Service Commission, Washington, D. C., prior to the hour of closing business on July 6, 1920.

The exact title of the examination desired, as stated in the application form.

An act of Congress approved July 11, 1919, provides:

"That hereafter in making appointments to clerical and other positions in the Executive branch of the Government in the District of Columbia or elsewhere preference shall be given to honorably discharged soldiers, sailors, and marines, and widows of such, and to the wives of injured soldiers, sailors, and marines who themselves are not qualified but whose wives are qualified to hold such positions."

The Attorney General holds that persons honorably discharged from the Coast Guard are entitled to the preference granted by this act.

Applicants entitled to preference should *attach to their applications* their original discharge, or a photostat or certified copy thereof, or their official record of service, which will be returned after inspection by the Commission.

Issued May 29, 1920.

PROLONGING THE LIFE OF THE "B" BATTERY

One of the greatest costs which the owner of a receiving outfit has to meet is the renewal of the "B" battery. The following suggestions, which were personally tried by the writer, will materially reduce this cost.

The inherent weakness of all dry cells is that the negative element (zinc) is also used as the container. When current is taken from the cell, the zinc is consumed but unfortunately the disintegration is usually not uniform. The zinc will develop one or more holes and the electrolyte within the cell runs out or evaporates. When the contents have become hard and dry, the cell is useless. To prevent this trouble the battery should be completely sealed in wax. In the case of the ordinary "B" battery, this is easily done. Simply cut the bottom of the cardboard container on three sides and turn it back like a cover. Then pour melted paraffine around the cells until the container is completely filled. Since the tops of the cells are already sealed in wax, the melted paraffine will not run out. The bottoms of the cells should also be covered with a layer of paraffine and then the cardboard bottom of the container may be turned back and fastened with passe partout. This procedure prevents the evaporation of the electrolyte when a hole falls into the zinc and if a new battery is so treated, its life will be materially lengthened.

If the battery is already dead it may be made into a wet battery provided the zincs are not too badly used up. In a block of wood drill as many holes as there are cells. The holes should be as deep as the height of the cell and about ¼" larger in diameter. After this the block should be thoroly impregnated with paraffine. The cells should be separated and about 20 holes punched in each zinc casing with a 1½" finishing nail. All cells should be connected in series with wires long enough to reach from hole to hole in the block. The top of each cell (after connection) should be dipt in paraffine and the cells placed into the holes in the wooden block. Then a solution of sal ammoniac (about 1 oz. to ½ pint of water) should be poured around each cell until the liquid level is within ⅛" of the top of the cell. As the electrolyte soaks into the cells, more should be added until it remains constant and after that plain water is added to replenish that lost by evaporation. After the cells have received new electrolyte in this way, a 22-volt battery will give about 17 volts and it will last for a long time.

Contributed by L. S. UPHOFF.

AUDIOTRON PATENT CONDITIONS SETTLED

We are creditably informed that the claims of the Audiotron Mfg. Co. had been fully upheld by the Federal Courts. The *audiotron* is now manufactured under both the De Forest and Fleming patents and is the only vacuum tube so licensed. It is no longer limited to audio frequency and is being sold for amateur and experimental use as a detector, amplifier or oscillator.

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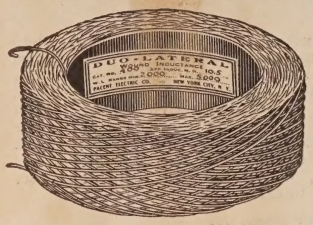

In endeavoring to give personal service to our ever growing clientele, we realize that new and more modern products make for the betterment and improvement of radio work and to this end we offer you the latest scientific achievement in radio

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made in several different sizes covering every wavelength, these coils have staggered winding and a lower natural period, lower high frequency resistance, very low distributed capacity, lower D. C. resistance and higher self inductance, which makes it an ideal part of any set and superior to all other coils for amateur work.

Radio Engineers have made extensive tests of these coils and give them their highest recommendations.

ORDER BY CATALOGUE NUMBER AS LISTED.

CATALOG NUMBER	WORKING WAVELENGTH RANGE IN METERS	INDUCTANCE IN MILLIHENRIES		LIST PRICE EACH UNMOUNTED
25	130 to 250	.045	.045	$ .90
35	180 to 450	.075	.073	1.00
50	250 to 700	.156	.15	1.10
75	400 to 900	.36	.34	1.20
100	500 to 1400	.66	.57	1.30
150	600 to 2000	1.40	1.35	1.40
200	1000 to 2500	2.50	2.30	1.50
250	1200 to 3500	4.2	4.	1.60
300	1500 to 4500	6.25	6.1	1.80
400	2000 to 5000	10.62	10.2	2.00
500	3000 to 6000	17.6	17.3	2.20
600	4000 to 10000	25.0	22.0	2.50
750	5000 to 12000	38.0	35.3	2.70
1000	8000 to 15000	72.8	68.3	2.90
1250	10000 to 20000	116.6	112.3	3.50
1500	15000 to 25000	171.5	162.2	4.00

We also carry a large stock of high grade electrical apparatus, including a very complete line of heating appliances.

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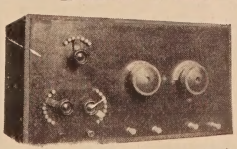

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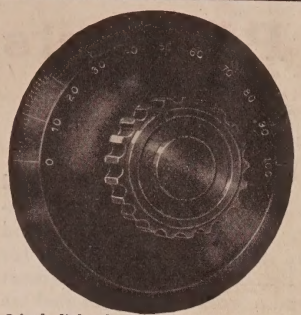

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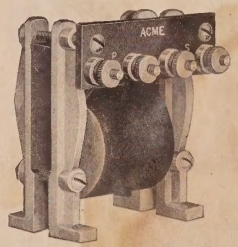

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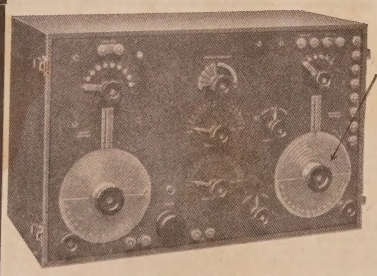

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We have been very fortunate in obtaining 10,000 Navy Type Dial Indicators for sale to amateurs. These dials are made of heavy white celluloid, highly polished, beautifully finished, and artistically engraved with two scales. One scale is divided into degrees; the other is calibrated for writing in station call letters at points at which station is received.

Put your set in the commercial class

Not only do these dials add dignity and beauty to a set, but they are also a real utility and a necessity for reliable work. Use them wherever you would an old fashioned scale and pointer.

Buy today—Tomorrow may be too late!

At the present rate of sale our stock will be exhausted within 60 days. So get the lead on the rest—lay in a supply now—while you can.

Price while they last 65c postpaid. Complete as described without knob (Stamps NOT accepted)

The C and S Radio Co. Department US6 Omaha, Nebraska

"Superlative Radio Engineering Productions"

Navy Broadcasts For Amateurs

Code Translations for Month of May

[*Ed. Note: Each month an abstract of the amateur code messages sent out by the New York Radio Station NAH will be published in* Radio Amateur News. *The purpose of this is so that amateurs who copy this code may have a means of checking up what they have received and thus know how they are progressing in receiving ability.*]

The following messages were broadcasted in the Amateur Radio Code by Navy Radio Station, New York City, N. Y., on 1500 meter wavelength, during May, 1920.

May 2—Code Ten—United States Atlantic Fleet arrived in North River New York May first.

May 2—Code Ten—United States Atlantic Fleet will remain in New York until May seventeenth special inducements will be offered to good men desiring to enlist for two years or more.

May 3—Code Two—Translation of amateur code messages sent during April was mailed to the Amateur Radio News May third period these translated copies are available to anyone requesting them.

May 4—English—Amateur Radio operators desiring to enlist in the United States Navy should visit the New York Naval Radio Station, 44 Whitehall Street, New York, where they may obtain valuable information relative to special inducements being offered during this period.

May 5—Code Four—All radio amateurs who have requested permission during past week to visit New York Naval Radio Station will be informed soon as conditions make possible to comply with their requests relative to lecture on Navy Radio activities.

May 6—Code Six—Arrangements are being made for Navy dirigibles to fly over fleet in North River, New York City, to take official pictures about May 8.

May 7—Code Eight—Atlantic fleet in North River, New York, will use radio telephones on three hundred and seventy-five meters after 8 A. M., May 10.

May 8—English—Headquarters Boy Scouts of America advise quote announced by Boy Scouts of America that Kansas Scouts tonight are holding mammoth demonstration with radio features at Wichita. National council sends greetings via NAH to demonstrate efficiency of Navy and Scout co-operation unquote.

May 9—English—Headquarters Boy Scouts of America advise quote many officials of Navy and merchant marine endorse seacoast program (stop) badges and insignia officially approved (stop) seascout department will conduct training courses June 5 to September, two at Kanohl Wahke scout camps, Palisades Interstate Park, New York (stop) Scouts fifteen and up eligible (stop) unquote.

May 10—English—A special training school has been opened for Amateur Radio operators who desire to enlist for two years in the Naval Communication Service. Address correspondence relative this matter to District Communication Superintendent, 44 Whitehall Street, New York City.

May 11—Code Ten—A reliable newspaper states the high power Washington Radio Station was inspected on May eighth by the Danish radio commission in connection with a proposed Danish American radio system.

May 13—Code Four—Boy Scouts of America advise quote one hundred and eighty cities including some in Honolulu and Porto Rico have started to get seascout ships many more expected help our country by learning seamanship in the scout way. Boys of fifteen or over may join. See the nearest scout executive unquote.

May 14—Code Six—Radio amateurs will be pleased to hear that arrangements have been made by the headquarters of

the Boy Scouts of America to give interesting lectures for all radio amateurs period invitations and dates of these lectures may be obtained from the Boy Scout Headquarters Fifth Avenue Building New York City.

May 15—Code Two—It is understood the Norwegian transatlantic radio service will be received after May seventeenth by the commercial radio stations at Marion and Chatham Massachusetts.

May 16—Code Eight—United States Navy Department expect to conduct a demonstrative radio test in New York harbor in connection with a new underwater radio cable to be used as an aid to navigation.

May 17—Code Two—Battleships of United States Atlantic Fleet left North River New York City for southern drill grounds May seventeenth.

May 18—Code Four—President signed on Saturday May fifteenth bill increasing rates of pay for enlisted men of the Navy period this involves a substantial increase for radio operators of all ratings.

May 19—No broadcast sent—SOS work.

May 20—Code Six—Previous service men who reenlist within one year from date of continuous service under the new pay bill may be granted the usual leave upon re-enlistment.

May 21—Code Eight—Following received from Boy Scouts of America quote Rear Admiral Benson in referring to Seascout work stated this plan is a very worthy one (stop) it seems to be adequate and something which the people of this country must be imbued with if we

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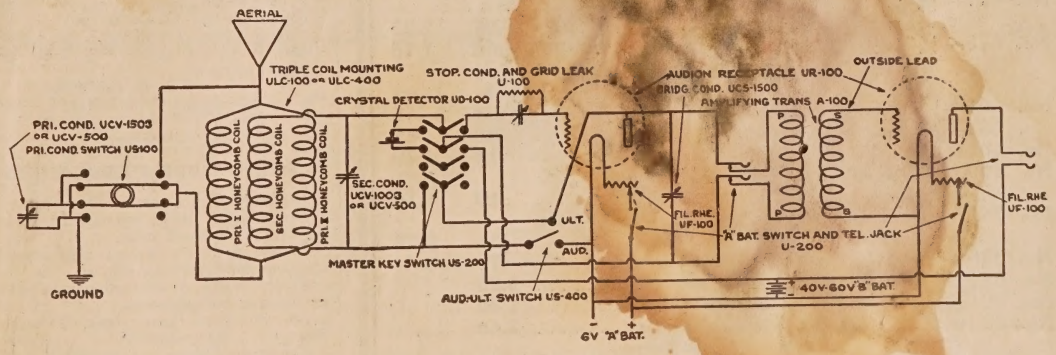

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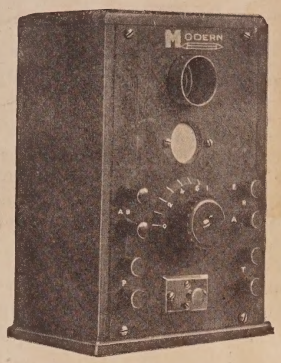

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	Each	Doz.
No. 601—½" dia., 8-32 bushing	$ .04	$ .45
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No. 606—1¼" dia., 13/16" high	.15	1.70
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No. 751—Brass finish Panel Switch, single blade, 1⅜" radius	.35	3.75
No. 850—3" Dial Indicator only	.70	each
No. 851—3" Dial Indicator with knob	1.25	"
No. 801—22.5 Volt "B" Battery, small	1.40	"
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are to become a leading merchant marine power (stop) unquote.

May 22—Code Two—Chief Scout executive James E. West, Boy Scouts of America announces quote Chief Seascout James A. Wilder sailed yesterday SS Roma for Europe to participate in International Boy Scout events period Seascouts messages can be forwarded via National Council office New York unquote.

May 23—Code Two—San Francisco Naval Radio Station transmits press with forty-eight hundred meter continuous wave at midnight daily, also sends time signals at noon and weather broadcast at 10 pm on same wavelength, San Francisco time.

May 24—English—San Diego Naval Radio Station transmits press with ninety-eight hundred meter continuous wave at 2 pm and 5 pm, western time.

May 25—Code Six—It is understood that the large arc radio station nearly completed at Croix d'Hins, France will have a capacity of one thousand kilowatts.

May 26—Code Eight—It is understood the old battleship Ohio will be used by the Navy as a radio experimental ship.

May 28—Code Ten—A radio compass station is building at Jupiter and it is expected that one will go in at Miami or vicinity.

May 30—Code Six—Following from Boy Scout Headquarters quote approximately one hundred and fifty Boy Scouts have been selected to attend International Jamboree London in August including Denver Scout Band of sixty pieces under leadership of Innes comma World Famous bandmaster period applications still coming in unquote.

May 31—Code Two—Following from Boy Scout headquarters quote announced by Merchant Marine Department American Library Association via Navy and Boy Scout Radio Service that it furnishes collections of books to men in Coast Guard comma Lighthouse and Lightship service period please tell local newspapers unquote.

R. B. COFFMAN,
Lieutenant Commander, U. S. N.

RADIO TERMS EXPLAINED.

Laminations, a book of The Bible.

Dropping a stitch, missing a pin when winding honeycomb coils.

Polarized, the way you felt when you touched the rotary to stop it.

Grid, the part of an audion that red lead or litharage is pasted on.

Interrupter, a Ham, static, a dead "B" Bat. Or a blown-out fuse.

Capacity, the amount of QRM you can stand.

Anode, an ode, the poet's way of expressing a thrill.

Kick-back, the effect on the pocketbook when a motor-generator is purchased.

Anchor gap, a spark gap on a large marble base.

Synchronism, when all electrodes of a rotary travel at the same speed.

Condenser, a storage battery that uses some solid for an electrolyte.

Ticker, the government clock at NAA.

Selectivity, the number of catalogs you have.

Contributed by D. W. DRURY.

SUBMARINE RADIOPHONE TEST SUCCESSFUL.

The new United States submarine S-4 recently arrived at Provincetown, Mass., after completing a successful trip devoted to testing radio telephone apparatus. It was stated that the submarine had picked up Provincetown at a distance of 600 miles by means of radiophone.

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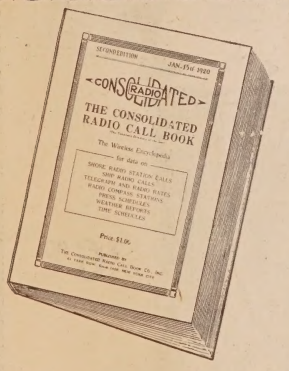

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The world's record for long distance weddings occurred recently, one of the contracting parties being in Detroit and the other "somewhere on the Pacific Ocean." It happened when Miss Mabelle Ebert became the bride of John R. Wakeman, a sailor aboard the cruiser *Birmingham*, altho the bridegroom was 1,000 miles off the California coast with the Pacific fleet, and the bride in the First Presbyterian Church in Detroit, Michigan.

About 8:30 in the morning in the mid-Pacific the radio operator aboard the cruiser called for John Wakeman, one of the gobs. When the nature of the message was made known the ship's chaplain called the crew to attention, with Sailor Wakeman at a point of vantage. The ship's radio transmitter was started and the marriage ritual was repeated slowly by the operator.

Miss Ebert and her friends were gathered in the church. The Rev. C. E. Mieras telephoned the bride's side of the ceremony to a telegraph office, whence it was wired to the huge radio station at the Great Lakes Naval Training Station, near Chicago. From there the ritual flashed out to the ship in mid-ocean.

A short time after the message left Detroit a messenger came to the church with the other half of the ceremony enclosed in a telegraph envelope. Upon the reading of this by the clergyman the ceremony was called complete and the bride and her friends began the usual celebration.

The bride does not know when she will see her husband nor does she know exactly where he is.

APPLICATIONS FOR RADIO CALL LETTERS.

Applications for radio call letters should be made to radio inspectors and collectors of customs at the different ports and not to the office of the Bureau in Washington. Applications for vessels should be made at the time application is made for the official number and signal letters and not before such time.

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Attention is invited to the fact that the following coast stations are open to general public service, at all hours, for communication with vessels at sea:

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CONCERNING RECEIVING DISTANCES.

When contributors send in articles concerning certain transmitting or receiving apparatus they have built and used, it is very desirable that they mention where the transmitting or receiving station is located with which they have communicated, that is to say, its exact location.

Many general statements are made concerning distances, but it is much better that specific names and places or call letters be mentioned so that the readers located in the various sections of the country may know just how and where to tune in for them.

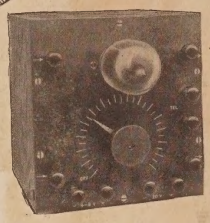
BUG LOSES FEELERS.

Pick: Jim McLaughlin is no longer a radio bug.

Mitt: Howzatt?

Pick: He lost his *antennae* in a storm.

—*Roland M. Fennimore.*



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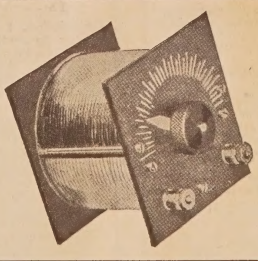

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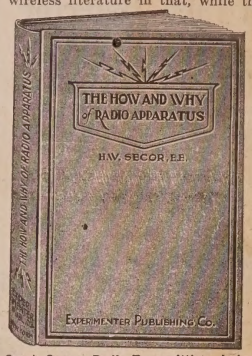

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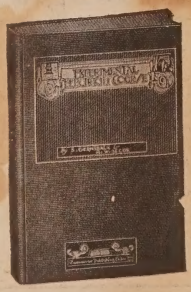

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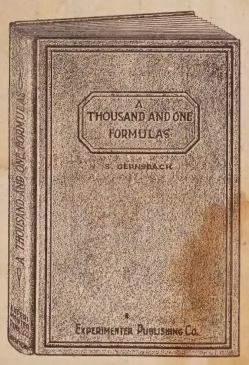

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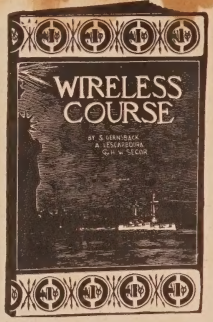

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"9ZN"

(Continued from page 26)

Central Division Manager for the American Radio Relay League, 9ZN is the Central Division distributing station of the United States and is accordingly connected by regular traffic routes to all other states in the Central Division. It is, therefore, but logical that the station enjoys the reputation of being called "the hub of the amateur radio universe" and is a general clearing house for all amateur messages going east, west, north or south. Moreover, it is not surprising that during the period from October 1 to March 1 nearly one thousand messages were handled by 9ZN, these messages being relayed thru the routes of the American Radio Relay League and no charge being made for the service.

With great foresight, no doubt brought to mind by the tremendous pressure of amateur traffic, Mr. Mathews is at present at work on a long distance radio telephone which should be a solution for 9ZN's traffic troubles and should, it is believed, shorten materially the operating hours of the station in relaying the messages by this more modern and much speedier method of communication.

Radio Dictionary

(Continued from page 29)

circuit of disc-mercury break down resistance of oil and make good contact between them. Oil once again insulates disc at completion of passage of oscillations. It is really a form of Coherer.

Logarithm—Log. In the case of common logarithms (Com. log) is the power of ten (the base) which produces the number in question. e. g., Log 100 equals 2, since 100 equals 10^2, 2 being the required power of 10 to produce 100. See Naperian Logs, Index of Log, Mantissa and Log Tables, also Anti-logs.

Logarithmic Curve—One having no definite minimum in a decreasing curve, or no definite maximum in an increasing curve. A dampt wave train has Logarithmic Curve.

Log Decrement—The Naperian or Hyperbolic log of reciprocal of the ratio of the first amplitude to second amplitude in a train of waves, or log of ratio of the amplitude of one oscillation to the next in same direction.

Log Tables—Tables giving the mantissa of Log of a number.

Lohys—A Silicon Steel.

Longitude—Distance east or west of a meridian passing through Greenwich, measured in degrees, minutes, and seconds.

Loops—Antinodes, Points of greatest amplitude in a wave train.

Low Frequency Current. L. F. C.—One having a frequency of only a few hundreds per second.

Low Frequency Iron Core Inductance—A variable inductance having an open-ended iron wire core. Used to place primary transformer circuit in resonance with alternating current frequency.

Low Tension. L. T.—Having only a small P. D. Low Pressure.

Lugs—Metal projections for simplifying the electrical connection of two articles. A small tube in end of which wire can be soldered, the other end being flattened out and having a hole drilled to receive any required terminal.

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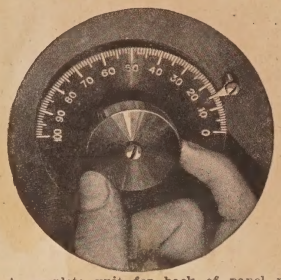

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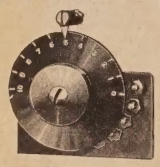

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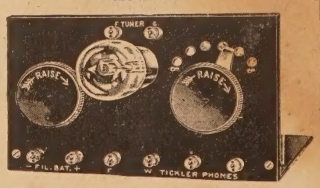

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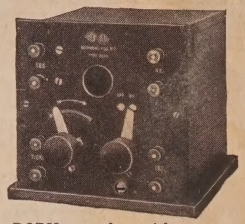

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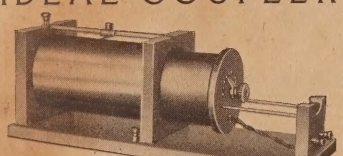
IDEAL COUPLER



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A REAL BARGAIN AT $10.50

Send Stamp For Description

CENTRAL RADIO SUPPLY

604 W. 60th St., Chicago, Ill.

Magnet—A piece of iron or steel having the power to attract other small pieces. See Electro-magnet. Loadstone. Permanent and Temporary Magnets.

Magnet Force—Force with which a magnet attracts or repels any piece of iron or steel.

Magnetic Battery—See Compound Magnet.

Magnetic Blowout—Electromagnet placed with its poles on either side of the key contacts, and connected up in such a manner that on releasing key current flows thru the coils producing a strong electro-magnetic field which "blows out" any small spark or arc at the contacts. It drives away Ionized gas.

Magnetic Coupling—Expression used by Germans to denote Inductive Coupling.

Magnetic Detector—Consists of a soft-iron wire band, slowly rotating thru a small transformer placed beneath two permanent magnets having their like poles adjacent. Primary windings of transformer are connected to earth and aerial while the telephones are connected across the secondary. Iron band passing beneath the magnets is in a series of constantly changing fields, thereby producing a strain on the magnetic lines of force. As an oscillation this strain breaks down, causing a sudden change in the magnetization of the iron band, which taking place within the secondary winding, causes an induced direct current to flow thru it and thus operate the telephones.

Magnetic Equator—Line encompassing the earth and passing at right angles to and thru the center of the Magnetic Meridian.

Magnetic Field—The whole space over which a magnet exerts its magnetic influence. It is the space traversed by Magnetic Flux set up by Magnetic Force of a magnet.

Magnetic Flux—Lines of force which flow from a magnet. Flow of magnetism by induction. Magnetic Induction.

Magnetic Force—Force at any point in a magnetic field which a unit quantity of magnetism would experience if placed at that point. Field Intensity.

Magnetic Hysteresis—Tendency to remain in old condition when a change of magnetic condition is taking place. Also known as Magnetic Lag.

Magnetic Induction—See Induction.

Magnetic Inductive Capacity—Magnetic Inductivity, or Magnetic Permeability. Air is taken as Unit. Compare Specific Inductive Capacity.

Magnetic Key—A magnetic relay used in conjunction with the manipulating key where alternating current is used, to prevent sparkling at and burning away of the platinum contacts. This effect is produced by short circuiting the key at every maximum value of the alternating current. Thus no matter at what period of a cycle the key is released there will be practically only a zero potential between the points.

Magnetic Lines of Force—Lines used for diagrammatically depleting a Magnetic Field.

Magnetic moment—Product of the strength of poles and the Virtual Length of a magnet.

Magnetic Needle—A thin strip of magnetized steel used in various instruments to denote polarity of a magnetized article.

Magnetic Poles—Points on a magnet where attraction is strongest. Of the Earth, North Magnetic Pole is situated in Lat. 70 N. and Long. 97 W. The South Poles is at Lat. 70 S. and Long. 102 E. Note that the Magnetic Poles do not coincide with the Geographical Poles.

Magnetic Pyrites—See Pyrites.

Magnetic Storm—A large irregular magnetic variation.

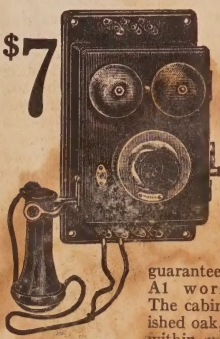
Magnetite—Naturally magnetic iron ore. Fe_3O_4. Brittle black substance. S.G. 5.2. See Loadstone.

For Homes, Offices, Factories, Farms

Complete Wall Set Magneto Telephone

Western Electric Type

$7



This is a complete commercial telephone station. They were bought from telephone exchanges who put in Central battery types. Slightly used but guaranteed to be in A1 working order. The cabinet is of polished oak, piano finish, within which is contained the powerful magneto, the 300 Ohm polarized ringer, and induction coil. The magneto is exceptionally efficient, being of the two bar type with brass gear transmission. The extra sensitive microphone, mouthpiece and two gongs are mounted on the front of the cabinet, giving the entire instrument that desirable appearance of compactness and efficiency. Guaranteed to work over 20 miles. The telephone receiver is a double poled one, and has a hard rubber case. Seven binding posts are provided for connections.

The instrument is one which we can offer with pride to our patrons at a ridiculously low price. It is unobtainable anywhere else at less than $15.00 and is an instrument unequaled in value for the price we ask. Size over all 11x10x8 in.

Long Distance Telephone Set—
One station **$7.00**
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Two stations
Shipping weight, 25 lbs..... **$13.00**

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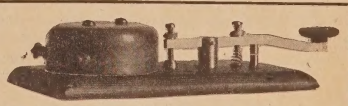

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Key made of solid brass, with screw adjustments.

Buzzer has pure silver contacts with external adjusting screw.

Key unmounted, 75 cts. Buzzers, 40 cts.
30 amp. batt. switches, S. T., 40c. D. T., 50c.

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FOUR DOLLARS EACH, POSTAGE PAID

We also have the standard four prong base at 60c

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Dalton and Belvidere St. Boston 17, Mass.

Magneto—Small generator, con... armature rotating between the ... two or more permanent magnets, usua... of the horse-shoe type. Used for motor ignition, and medical coils.

Manganese Mn.—Metallic element with reddish tinge, somewhat similar to iron but harder and very brittle. A. W. 54.6. S. G. 7.4.

Manganin—An alloy of 84% Copper, 12% Manganese, and 4% Nickel.

Manipulating Key—See Key.

Mantissae—Figures to right of point in a Long Number. Decimal portion of log. The values given in Log Tables are Mantissae only.

Marconi Filings Coherer—Detector consisting of fine metallic filings contained in a suitable glass tube between two electrodes of platinum. Resistance of filings greatly decreased by their "packing" when oscillations pass thru. Re-sensitized by an automatic tapping device. It is (or rather was, as it is out of date) used as a relay. It is not efficient for rapid working owing to the time required to resensitize after the passage of each wave.

Marine Type Switchboard—A switchboard having resistance coils of four Ohms, two carbon filament lamps, one single pole two-way switch, one double pole two-way switch, and a voltmeter. Used, by varying position of the switches, for charging and discharging the accumulators. Also enables the induction coil to be worked either from the ship's supply or from the cells.

Mass—Quantity of matter in a body not Weight, which see. Mass equals Volume x Density.

Massicot—See Litharge.

Maxwell's Corkscrew Rule—If a corkscrew be screwed in direction of flow of current, the corkscrew will rotate in direction of the magnetic lines produced by that current.

Mean Solar Day—Average time of a year's Apparent Solar Days.

Mechanical Compound—Two or more elements mixed together but not chemically combined. Compare Chemical Compound.

Mega—One million.

Megger—Improved form of Ohm Meter.

Megohm—One Million Ohms.

Megomite—A substance very similar to Micanite.

Mercury. Hg. Hydrargyrum—Commonly known as Quicksilver. Metallic element, liquid at ordinary temperatures. A.W. 198.5. S.G. 13.958. Mlt. Pt. 40°F. Val. 2. Chem. Eq. 2. Elec. Chem. Eqv. 0.001,-037,4. S.R. 94.07.

Mercury Jet Interrupter—Rapid make-and-break operated by a rotating mercury jet making momentary contact between two ends of a circuit.

Meridians—Imaginary great circles, drawn so as to pass thru both poles of the earth, and crossing the equator at right angles. There is the Magnetic Meridian as well as the Geographic Meridian, but they do not coincide.

Mesh Grouping—See Delta.

Metric System of Units—C.G.S. Centimeter, Gramme, Second.

Mfds.—See Microfarad.

Mg.—See Magnesium.

Mho.—Unit of Conductivity. Is the reciprocal of the resistance.

Mica—A non-inflammable, transparent mineral, which splits up into extremely fine plates. S.I.C. varies from 5 to 6.

Micanite—Trade name of a manufactured insulator. Consists of sheets of Mica fixed together with insulating cement and by intense heat. Can be prepared in any desired form.

Micanite Cloth. Or Micanite Paper—This is mica cemented to cloth or paper.

Micro—One-millionth.

Microfarad—Mfd. Practical unit of capacity. Millionth part of a Farad. See Farad.

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Variable Condensers

(*Die-Cast Type*)

No. 1.—.0011 m.f. mounted. $5.00
No. 2.—.0006 m.f. mounted. $4.50
No. 3.—.0011 m.f. unmounted $4.50
No. 4.—.0006 m.f. unmounted $4.00

...adenser No. 1

Top, bottom and knob are genuine bakelite, shaft of steel running in bronze bearings, adjustable tension on movable plates, large scale reading in hundredths, high amply separat... and accurately spaced ...tes.

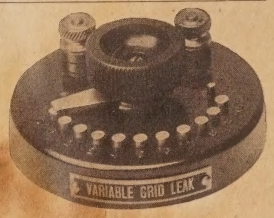
Unmounted t... s will fit any panel and are equipped with counter-weight.

VARIABL... RID LEAK

Permits the se... of the proper leak resistance regard... the type of tube, or its use as dete... mplifier or oscillator. Ten steps give ... from ½ to 5 megohms. Genuine bakelite base and knob.

All our apparatus embodies the highest degree of mechanical construction, electrical efficiency, and good appearance.

Immediate Delivery—Catalog sent upon request



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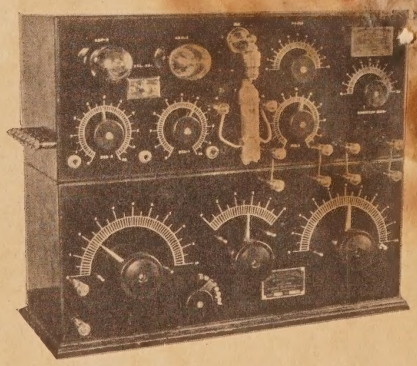

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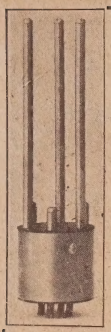

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Consists of standard 4 prong base with brass supporting connectors. Permits mounting tube in vertical position so filament will not sag and touch grid.

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NEW "VT" SOCKET

$1.00. Marconi Grid Leak (without base, 55c.
Mica-Copper-Foil Grid Condenser, 40c.
We strongly recommend our 44 Volt Variable "B" Battery for use with Detector "VT's", $3.80.
Moorhead Electron Relays, $6.00. (With standard base. See Moorhead adv.)
$10 General Radio Ammeters, $5. (0-2½ amps. for antenna radiation or filament current indication.)

PARAGON RHEOSTAT

The 6 ohm resistance permits fine filament control within 4 or 6 volts. 2 ohm. See March R. A. N. page 467, for details. Shaft reversible for back mounting.

$1.75 POSTPAID

Western Electric P-1 Army-Navy Phones, $12. Special Acme Amplifying Transformers to use with above phones. $4.50 unmounted. With stands, $6.

GROUND WIRE, 8c Per Ft., $7 Per 100 Ft.
Good 100 Amp. 600 V. Lightning Switches, $4.

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COMBINATION NO. 1

	Reg. Price
2 Switches, nickeled laminated blades, 2" radius	$1.40
24 Nickeled Switch Points, ¼" high, ¼" dia. with ⅜" screws	.70
	$2.10

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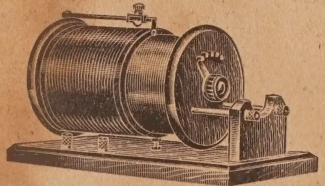
This is our popular $7.50 Loose Coupler. Made of the best material, mahogany finish. Wave length approx. 1,200 meters. Postage extra.



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Micr... Spa... able spark ... hundredths o... aerial circuit... heavy charge... sparkling a...

Microphon... Varying pressure... ...res cause a diaf... its normal pressu... ...l su... ...uctors, this in turn equally varying the electrical resistance of the points of contact, thus permitting a current whose strength varies as the imposed sound waves to pass into a telephone.

Mil. F. P. S.—Unit of small length, one-thousandth part ... inch.

Mil Foot—A wir... foot long having a diameter of on... ...

Mil Amp.—One ... sandth part of an Ampere.

Minium—See ... ead.

Mirror Galva...—Reflecting Galvanometer. One ... for measuring very small currents ... a beam of light reflected from ... mirror suspended on the moving a... needles. Thus a very slight deflection becomes greatly magnified, since the beam of light naturally moves through a greater distance when far from the mirror than a short pointer could do.

Mn.—See Manganese.

MnO_2—Manganese Dioxide.

Molecule—The smallest group of atoms of an element or compound which can exist by themselves. Kelvin stated that if a drop of water could be magnified to the size of the earth its component molecules would be the size of cricket balls.

Molybdenite—A lead gray sulphide of Molybdenum, MoS_2. Used as a Rectifier-detector in contact with copper.

Momentum—Of a body is quantity given by the product of its Mass and Velocity. C.G.S. unit is one pound with velocity of one foot per second, C.G.S. unit is one gramme with velocity of one centimeter per second.

Morse—Samuel F. B. Morse, an American, was the first to devise a method of sending intelligible signals by means of electrical impulses of varying duration along a wire. This system is the well-known Morse code. There are two generally used forms of this code, the American and the universal or Continental Morse. The latter is now universally used except in certain countries where special codes have been formed to meet the requirements of the local language, such as Japan and Turkey, etc.

Moscicki Condenser—One in which the dielectric thickens out at the edges. Usually in the form of a glass tube, coated inside and out with metal-foil. The tube thickens at ends. Designed to minimize brush discharge or corona effect at edges of a condenser.

Morse Inker—An instrument for recording Morse code signals in the form of dots and dashes on a travelling paper band.

Motor—Any machine which converts electrical power into *mechanical power*. Usually built with a construction similar to that of a dynamo.

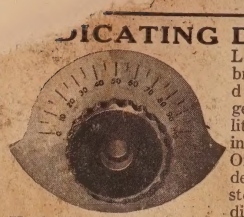
Design of a Receiving Set

(*Continued from page* 11)

able condenser C_B. The oscillator is coupled to the receiving circuit thru the coils L_S and L_B.

To be concluded in the August issue; watch for it, and preserve this copy for reference.

...DICATING DIALS



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Nickeled Contact Studs 3/16"x3/16" dia. per doz.	20c
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